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INTRODUCTION

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Certain publications abstracted in *STAR* are given analytic treatment, with citations and abstracts of daughter items following immediately after the parent document. When the subject content of a daughter differs from that of its parent, a cross-reference citation is printed at the end of the category to which the daughter would normally have been assigned.

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IAA is available on subscription from the American Institute of Aeronautics and Astronautics, Technical Information Service, 750 Third Avenue, New York, NY 10017, at the following annual rates:

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depositories are described in a booklet, *Science Information Available from the Atomic Energy Commission* (TID-4550), which may be obtained without charge from the USAEC Technical Information Center.

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The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is used as the authority for the indexing vocabulary that appears in the subject index. The *NASA Thesaurus* should be consulted in examining the current indexing vocabulary, including associated cross-reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the National Technical Information Service or the U.S. Government Printing Office at $8.50 for the three-volume set. The first two volumes of this Thesaurus, consisting of the alphabetical listing of subject terms (A–Z), have been superseded by the following single-volume publication: *NASA Thesaurus Alphabetical Update* (September 1971) (NASA SP-7040), available from NTIS for $6.00. (Volume III of the Preliminary Edition consists of the following ancillary aids to vocabulary selection: heirarchical display of index terms, category term listing, permuted index, and a listing of postable terms only.)

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02 Aircraft 2636
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc.; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

03 Auxiliary Systems 2641
Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

04 Biosciences 2643
Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

05 Biotechnology 2647
Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

06 Chemistry 2650
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

07 Communications 2652
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09 Electronic Equipment 2661
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10 Electronics 2664
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories.

11 Facilities, Research and Support 2665
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

12 Fluid Mechanics 2668
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

13 Geophysics 2674
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Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

19 Mathematics 2723
Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers.

20 Meteorology 2725
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

21 Navigation 2729
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

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Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

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30 Space Sciences 2749
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbits and trajectories. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

31 Space Vehicles 2755
Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

32 Structural Mechanics 2758
Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

33 Thermodynamics and Combustion 2767
Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

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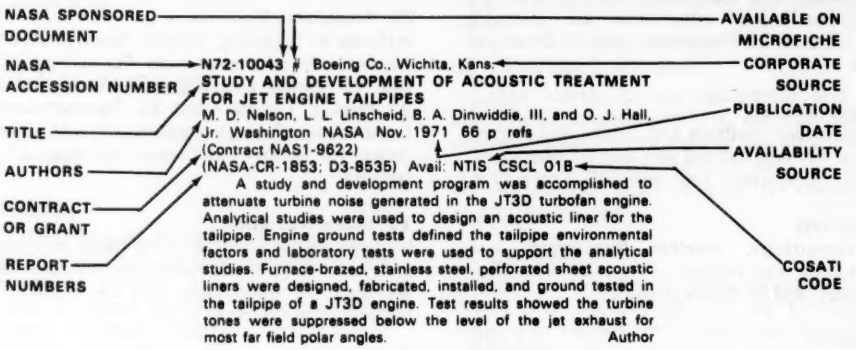
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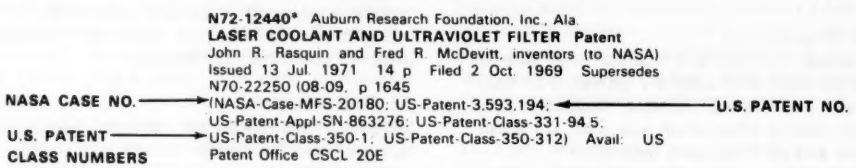
N72-10043 # Boeing Co., Wichita, Kans.
STUDY AND DEVELOPMENT OF ACOUSTIC TREATMENT FOR JET ENGINE TAILPIPES
M. D. Nelson, L. L. Linscheid, B. A. Dinwiddie, III, and O. J. Hall, Jr. Washington NASA Nov. 1971 66 p refs
(Contract NAS1-9622)
(NASA-CR-1853; D3-8535) Avail: NTIS CSCL 01B
A study and development program was accomplished to attenuate turbine noise generated in the JT3D turbofan engine. Analytical studies were used to design an acoustic liner for the tailpipe. Engine ground tests defined the tailpipe environmental factors and laboratory tests were used to support the analytical studies. Furnace-brazed, stainless steel, perforated sheet acoustic liners were designed, fabricated, installed, and ground tested in the tailpipe of a JT3D engine. Test results showed the turbine tones were suppressed below the level of the jet exhaust for most far field polar angles. Author

PATENT CITATION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U.S. PATENT CLASS NUMBERS
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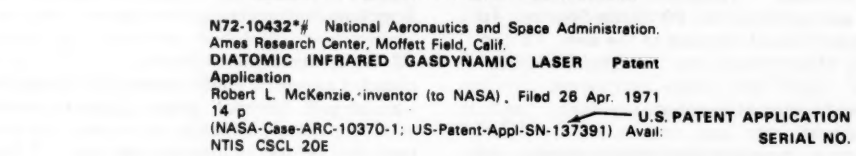
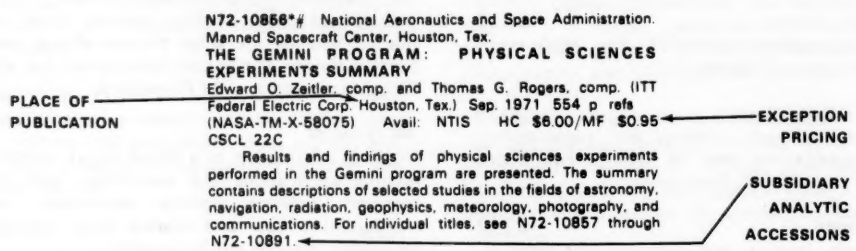
N72-12440* Auburn Research Foundation, Inc., Ala.
LASER COOLANT AND ULTRAVIOLET FILTER Patent
John R. Rasquin and Fred R. McDevitt, inventors (to NASA)
Issued 13 Jul. 1971 14 p Filed 2 Oct. 1969 Supersedes N70-22250 (08-09, p 1645
(NASA-Case-MFS-20180; US-Patent-3,593,194; US-Patent-Appl-SN-863276; US-Patent-Class-331-94.5; US-Patent-Class-350-1; US-Patent-Class-350-312) Avail: US Patent Office CSCL 20E

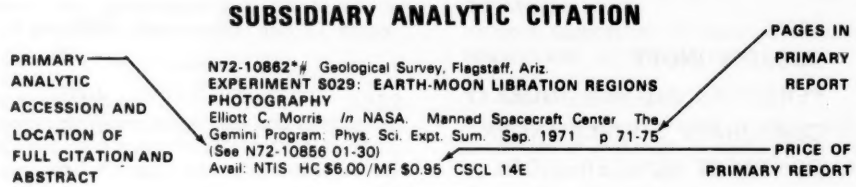
PATENT APPLICATION CITATION


U.S. PATENT APPLICATION SERIAL NO.
N72-10432*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DIATOMIC INFRARED GASDYNAMIC LASER Patent Application
Robert L. McKenzie, inventor (to NASA). Filed 26 Apr. 1971 14 p
(NASA-Case-ARC-10370-1; US-Patent-Appl-SN-137391) Avail: NTIS CSCL 20E

PRIMARY ANALYTIC CITATION AND ABSTRACT


PLACE OF PUBLICATION
EXCEPTION PRICING
SUBSIDIARY ANALYTIC ACCESSIONS
N72-10856*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THE GEMINI PROGRAM: PHYSICAL SCIENCES EXPERIMENTS SUMMARY
Edward O. Zeitler, comp. and Thomas G. Rogers, comp. (ITT Federal Electric Corp., Houston, Tex.) Sep. 1971 554 p refs
(NASA-TM-X-58075) Avail: NTIS HC $6.00/MF $0.95 CSCL 22C
Results and findings of physical sciences experiments performed in the Gemini program are presented. The summary contains descriptions of selected studies in the fields of astronomy, navigation, radiation, geophysics, meteorology, photography, and communications. For individual titles, see N72-10857 through N72-10891.

SUBSIDIARY ANALYTIC CITATION


PRIMARY ANALYTIC ACCESSION AND LOCATION OF FULL CITATION AND ABSTRACT
PAGES IN PRIMARY REPORT
PRICE OF PRIMARY REPORT
N72-10862*# Geological Survey, Flagstaff, Ariz.
EXPERIMENT S029: EARTH-MOON LIBRATION REGIONS PHOTOGRAPHY
Elliott C. Morris *In* NASA. Manned Spacecraft Center The Gemini Program. Phys. Sci. Expt. Sum. Sep. 1971 p 71-75
(See N72-10856 01-30)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

VOLUME 10 NUMBER 20 / OCTOBER 23, 1972

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N72-28992*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

NUMERICAL CALCULATION OF BOUNDARY-INDUCED INTERFERENCE IN SLOTTED OR PERFORATED WIND TUNNELS INCLUDING VISCOUS EFFECTS IN SLOTS

James D. Keller Washington Aug. 1972 22 p refs

(NASA-TN-D-6871; L-8349) Avail: NTIS HC $3.00 CSCL 20D

A numerical method is presented for calculating the incompressible boundary-induced interference in wind tunnels of rectangular cross section with slotted or perforated walls. The method includes a wall representation which is capable of satisfying a generalized homogeneous boundary condition including the effects of viscosity within the slots. The effects of viscosity in the slots are found to be very significant. The method allows for a variation in the boundary conditions along the tunnel walls. The model can be any configuration and can be located anywhere in the test section. The interference can be computed at any point in the test section. Author

N72-28993*# National Aeronautical Establishment, Ottawa (Ontario).

EXPERIMENTAL DAMPING-IN-PITCH OF TWO SLENDER CONES AT MACH 2 AND INCIDENCES UP TO 30 DEG

S. Iyenger Jan. 1972 25 p refs

(Contract NASw-1947)

(NASA-CR-114483; LTR-UA-19) Avail: NTIS HC #3.25 CSCL 01A

Oscillatory experiments were performed on two slender cones at Mach 2 and incidences up to 30 deg, using three different experimental arrangements. The damping-in-pitch was found to remain constant at incidences of up to a value approximately corresponding to the cone semi-angle, after which an almost linear increase with incidence was noted. The results obtained with the different techniques were in very good agreement up to an incidence of 15 deg and in some cases up to 25 deg. Author

N72-28994*# Nielsen Engineering and Research, Inc., Mountain View, Calif.

CALCULATIVE TECHNIQUES FOR TRANSONIC FLOWS ABOUT CERTAIN CLASSES OF WING BODY COMBINATIONS

Stephen S. Stahara and John R. Spreiter Washington NASA Aug. 1972 99 p refs

(Contract NAS2-6259)

(NASA-CR-2103) Avail: NTIS HC $3.00 CSCL 01A

Procedures based on the method of local linearization and transonic equivalence rule were developed for predicting properties of transonic flows about certain classes of wing-body combinations. The procedures are applicable to transonic flows with free stream Mach number in the ranges near one, below the lower critical and above the upper critical. Theoretical results are presented for surface and flow field pressure distributions for both lifting and nonlifting situations. Author

N72-28995# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

AN APPROXIMATE TREATMENT OF THE STABILITY OF A TOWED UNBANKED OBJECT IN A CONDITION OF ZERO LIFT

H. R. Hopkin London Aeron. Res. Council 1971 33 p refs Supersedes RAE-TR-69076; ARC-31359

(ARC-R/M-3675; RAE-TR-69076; ARC-31359) Avail: NTIS HC $3.75; HMSO: £1.20; PHI: $4.90

An approximate method is given for assessing the stability of a towed object. The analysis is developed in terms of lateral stability but can be simply translated to deal with the longitudinal case. Stability criteria are derived which involve a number of parameters including the mass and moment of inertia of the body its drag and transverse aerodynamic force and yawing moment characteristics, and the vertical separation between towed body and the tug. Formulas and charts are given for application of the method. Author (ESRO)

N72-28996# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

THE TWO-DIMENSIONAL FLOW AROUND A SLOTTED FLAP

D. N. Foster, H. P. A. H. Irwin, and B. R. Williams London Aeron. Res. Council 1971 70 p refs Supersedes RAE-TR-70164; ARC-32681

(ARC-R/M-3681; RAE-TR-70164; ARC-32681) Avail: NTIS HC $5.50; HMSO £2.45; PHI $9.60

Experimental measurements and theoretical analysis of the flow around a wing with a single slotted flap under two-dimensional flow conditions are reported. The particular experimental techniques of testing and measurement are described. The results show that the measured flow is strongly dependent on the inviscid solution for the flow around the wing and the flap, and that near to the optimum flap position there is only weak interference between the wake from the wing and boundary layer on the flap. The reasons for the occurence of an optimum flap position are given, and some comments made on the influence of Reynolds number on this position.

Author (ESRO)

N72-28997# National Physical Lab., Teddington (England). Aerodynamics Div.
THE VORTEX DRAG OF A SWEPT WING WITH PART-SPAN FLAPS
H. C. Garner London Aeron. Res. Council 1972 19 p refs Supersedes ARC-32395
(ARC-R/M-3695; ARC-32395) Avail: NTIS HC $3.00; HMSO 70p; PHI: $2.95

Two theoretical methods of calculating the vortex drag factor from a prescribed spanwise loading and a novel third method, on the reverse-flow principle without a definitive spanwise loading, are applied to an untapered swept wing with symmetrically deflected outboard flaps. Results are consistent within + or - 1 1/2 percent. The third method is used to study the large influence of flap span and chord. Author (ESRO)

N72-28998# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
EXPLORATORY TESTS ON A FORWARD-MOUNTED OVERWING ENGINE INSTALLATION
D. J. Kettle, A. G. Kurn, and J. A. Bagley London Aeron. Res. Council 1972 60 p refs Supersedes RAE-TR-70150; ARC-32661
(ARC-CP-1207; RAE-TR-70150; ARC-32661) Avail: NTIS HC $5.00; HMOS 95p: PHI $3.90

Wind-tunnel tests have been made to assess the aerodynamic potential of an overwing installation for fan-jet engines on a typical modern transport aeroplane. Low-speed tests on a complete model with free-flow nacelles and tests at higher speed on a partial model incorporating a blown jet are described. It is concluded that the lift-dependent drag associated with such an installation would be significantly greater than that of a conventional underwing engine installation. Author (ESRO)

N72-28999# Royal Aircraft Establishment, Farnborough (England). Structures Dept.
BOUNDARY-LAYER PRESSURE FLUCTUATIONS AT HIGH REYNOLDS NUMBERS ON A FREE-FLIGHT TEST VEHICLE
D. R. Roberts London Aeron. Res. Council 1972 60 p refs Supersedes RAE-TR-71033; ARC-33171
(ARC-CP-1208; RAE-TR-71033; ARC-33171) Avail: NTIS HC $5.00; HMSO: 90p; PHI: $3.65

Measurements were made of the boundary-layer pressure fluctuations on the body of a free-flight aerodynamic test vehicle powered by a solid-fuel rocket motor. The vehicle reached a maximum Mach number of 2.2 with a maximum Reynolds number of about 215 millions. Pressure spectra were deduced, and were found to compare reasonably with a theoretical spectrum for homogeneous isotropic turbulence. The scale of the boundary-layer turbulence was found to fluctuate between 47% and 76% of the turbulence boundary-layer thickness over a range of Mach numbers from 1.5 to 2.2, while being essentially equal to 50% of this thickness over the range M = 2.0 to M = 2.2. At M = 2.2 the root mean square boundary-layer pressure was equal to 0.0045 of the free stream dynamic pressure.
Author (ESRO)

N72-29000# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AERODYNAMICS
A. M. Mkhitaryan 7 Feb. 1972 326 p refs Transl. into ENGLISH from the publ. "Aerodinamika" 1970 p 175-428
(Contract F33657-71-D-0057)
(AD-740190; FTD-HC-23-720-71) Avail: NTIS CSCL 01/1

The book deals with the fundamentals of aerodynamics in application to passenger aircraft configurations and includes the laws of motion of gases and bodies submerged in them, similarity laws for gas flows, and the fundamentals of finite-wing and boundary-layer theory. The characteristics of the earth's atmosphere are presented. Aerodynamic experiment techniques and equipment are described. The aerodynamic characteristics of wing profiles, wings and tails of various shapes, bodies of revolution, and the airplane as a whole are examined. Special chapters are devoted to the specific features of hypersonic aerodynamics and fundamentals of airscrew (puller and pusher) theory. Author (GRA)

N72-29001# Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.
THE CONTROL VOLUME CONCEPT IN AERONAUTICAL ENGINEERING M.S. Thesis
Carlos Tromben Corbalan Dec. 1971 88 p refs
(AD-741132) Avail: NTIS CSCL 01/2

The thesis is concerned with the fundamental physical laws of continuity, momentum, and energy used in aeronautical engineering which are transformed from the control mass or system form into the control volume form. It is intended for the document to serve as a self-studying guide for students in the core of the aeronautical engineering program at the Naval Postgraduate School and as a reference during the graduate level courses. GRA

N72-29002# Martin Marietta Corp., Baltimore, Md. Research Inst. for Advanced Studies.
COMPLETE SOLUTION FOR LIFTING WINGS WITH PARABOLIC TIPS
Peter F. Jordan Mar. 1972 70 p refs
(Contract F44620-69-C-0096; AF Proj. 9781)
(AD-741883; RIAS-TR-72-040; AFOSR-72-0814TR) Avail: NTIS CSCL 01/1

A complete investigation of the solution for lifting wings with parabolic wing tips is presented. All the leading components of the tip pressure singularity are identified. Specific solutions differ from each other by the amplitudes of elements which converge to higher order at the tip; the order of convergence of the specific components also is established. The model used in the analysis is the circular wing in incompressible flow, but the essence of the results is valid for wings of any aspect ratio. For the circular wing, several numerical solutions are given to high accuracy, and several conclusions of immediate technical interest are drawn. As a by-product of the analysis summation formulas for infinite progressions which involve the logarithm were developed. Author (GRA)

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N72-29003*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COOLANT PRESSURE AND AIRFLOW DISTRIBUTION IN A STRUT-SUPPORTED TRANSPIRATION-COOLED VANE FOR A GAS TURBINE ENGINE
Albert Kaufman, David J. Poferl, and Hadley T. Richards Washington Aug. 1972 25 p refs
(NASA-TN-D-6916; E-6800) Avail: NTIS HC $3.00 CSCL 20D

An analysis to predict pressure and flow distribution in a strut-supported wire-cloth vane was developed. Results were compared with experimental data obtained from room-temperature airflow tests conducted over a range of vane inlet airflow rates from 10.7 to 40.4 g/sec (0.0235 to 0.0890 lb/sec). The analytical method yielded reasonably accurate predictions of vane coolant flow rate and pressure distribution. Author

N72-29004*# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

EXAMINATION OF THE COLLISION FORCE METHOD FOR ANALYZING THE RESPONSES OF SIMPLE CONTAINMENT/DEFLECTION STRUCTURES TO IMPACT BY ONE ENGINE ROTOR BLADE FRAGMENT

Robert M. Zirin and Emmett A. Witmer May 1972 163 p refs (Grant NGR-22-009-339)

(NASA-CR-120952; ASRL-TR-154-6) Avail: NTIS HC $10.25 CSCL 01B

An approximate collision analysis, termed the collision-force method, was developed for studying impact-interaction. of an engine rotor blade fragment with an initially circular containment ring. This collision analysis utilizes basic mass, material property, geometry, and pre-impact velocity information for the fragment, together with any one of three postulated patterns of blade deformation behavior: (1) the elastic straight blade model, (2) the elastic-plastic straight shortening blade model, and (3) the elastic-plastic curling blade model. The collision-induced forces are used to predict the resulting motions of both the blade fragment and the containment ring. Containment ring transient responses are predicted by a finite element computer code which accommodates the large deformation, elastic-plastic planar deformation behavior of simple structures such as beams and/or rings. The effects of varying the values of certain parameters in each blade-behavior model were studied. Comparisons of predictions with experimental data indicate that of the three postulated blade-behavior models, the elastic-plastic curling blade model appears to be the most plausible and satisfactory for predicting the impact-induced motions of a ductile engine rotor blade and a containment ring against which the blade impacts. Author

N72-29005# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORT. APACHE AIRLINES, INCORPORTAED, DE HAVILLAND DH-104-7AXC, N4922V, COOLIDGE, ARIZONA, 6 MAY 1971

1 Jun. 1972 15 p refs

(NTSB-AAR-72-19) Avail: NTIS HC $3.00

Apache Airlines, Inc., De Havilland Model 104-7AXC, crashed near Coolidge, Arizona, on 6 May 1971, at approximately 1315 m.s.t., while en route from Tucson to Phoenix, Arizona. The aircraft was observed to enter a shallow dive which steepened as the aircraft approached the ground. The right wing separated from the fuselage just prior to ground impact. The aircraft disintegrated upon impact and all 10 passengers and the two crewmembers were fatally injured. Author

N72-29006*# Techtran Corp., Glen Burnie, Md.

INFLUENCE OF THE FLEXIBILITY OF THE ROTOR ELEMENTS ON THE DYNAMIC DEFLECTION OF THE ROTOR AS A WHOLE

N. G. Samarov Washington NASA Aug. 1972 13 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), v. 14, no. 2, 1971 p 67-75

(Contract NASw-2037)

(NASA-TT-F-14390) Avail: NTIS HC $3.00 CSCL 01B

The qualitative influence of an eccentricity of the rotor elements on the dynamic deflection of the rotor is assessed. It is shown that the dynamic deflection of the axis of a rotor of composite design is influenced not only by an eccentricity of the shaft but also by that of the individual rotor elements, in particular of disks and blades. The deflection caused by the individual elements is shown to vary as a function of the rpm to a greater extent than the deflection caused by the eccentricity of the rotor as a whole. A method of determining the rotor imbalance both along the length and radius (and, consequently, determining the spots where balancing loads should be applied) is proposed. Author

N72-29007# National Transportation Safety Board, Washington, D.C.

A STUDY OF US AIR CARRIER ACCIDENTS, 1964 - 1969

10 May 1972 384 p refs

(NTSB-AAS-72-5) Avail: NTIS HC $21.25

The record of aircraft accidents which occurred in U.S. Air Carrier Operations during the period 1964-69 is presented. It includes a statistical recapitulation of all accidents, an analysis, a brief of each accident, and a reference section consisting of several cross reference listings. Author

N72-29008# National Transportation Safety Board, Washington, D.C.

AIRCRAFT ACCIDENT REPORT: FEDERAL AVIATION ADMINISTRATION DOUGLAS DC-3C, N7, LA GUARDIA AIRPORT, NEW YORK, 4 JANUARY 1971

3 Jun. 1971 16 p

(NTSB-AAR-71-11) Avail: NTIS HC $3.00

A Federal Aviation Administration Douglas DC-3C crashed approximately 2,000 feet short of the approach threshold of Runway 4 at La Guardia Airport, New York, January 4, 1971, at 1832 e.s.t. The crew was attempting to fly an instrument landing system approach in instrument meteorological conditions, at night. The board determines that the probable causes of this accident were: (1) failure of the pilot to recognize the windshear condition and compensate for it; (2) the lack of crew coordination in that the copilot did not monitor the approach due to a selfinduced communications problem and failed to warn the pilot that the aircraft was too low; and (3) the diversion of the pilot's attention from his primary task of completing the approach and landing. These conditions resulted in a mismanaged ILS and landing approach and the continuation of the descent into ground obstructions. Author

N72-29009*# United Aircraft Corp., Stratford, Conn.

APPLICATION OF BORON/EPOXY REINFORCED ALUMINUM STRINGERS AND BORON/EPOXY SKID GEAR FOR THE CH54B HELICOPTER TAIL CONE. PHASE 2: FABRICATION, INSPECTION AND FLIGHT TEST Final Report, May 1971 - Mar. 1972

R. T. Welge 28 Aug. 1972 68 p refs Sponsored in part by Army

(Contract NAS1-10459)

(NASA-CR-112101) Avail: NTIS HC $5.50 CSCL 01B

A CH-54B Skycrane helicopter was fabricated with boron/epoxy reinforced stringers in the tail cone and boron/epoxy tubes in the tail skid. The fabrication of the tail cone was made with conventional tooling, production shop personnel, and no major problems. The flight test program includes a stress and vibration survey using strain gages and vibration transducers located in critical areas. The program to inspect and monitor the reliability of the components is discussed. Author

N72-29010# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

AN EXPERIMENTAL INVESTIGATION OF HIGH-SPEED ROTORCRAFT DRAG Final Report

James C. Linville Fort Eustis, Va. AAMRDL Feb. 1972 215 p refs

(Contract DAAJ02-70-C-0018; DA Proj. 1F1-62203-AA-41)

(AD-740771; SER-50713; USAAMRDL-TR-71-46) Avail: NTIS CSCL 01/3

An experimental investigation was carried out to determine the effect of subsonic Mach number on the drag characteristics of a high-speed wingless and winged helicopter when equipped with two different rotor head fairings. A simulated unfaired rotor head was provided as a basis for comparison. Tests were performed using a 1/9th scale model of a 60,000-pound class helicopter design. Data acquired included gross model force and rotor head force data, wing and pylon surface pressures, and tuft photos. GRA

N72-29011# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

NOISE FROM AIRCRAFT OPERATIONS AT MIRAMAR

NAVAL AIR STATION, CALIFORNIA AND LAND USE INTERPRETATIONS
Dec. 1971 81 p refs
(Contract N62474-71-C-4781)
(AD-740393; BBN-2098) Avail: NTIS CSCL 20/1

The purpose of the report is to define the noise environment due to military aircraft operations in the vicinity of Miramar Naval Air Station. The noise environment is depicted by means of several noise contours which are interpreted in terms of expected impact on land usage. The major purpose of the study is to provide interpretations of the aircraft noise as an aid in the compatible development of land surrounding Miramar Naval Air Station. Author (GRA)

N72-29012# Boeing Co., Seattle, Wash. Aeronautical and Information Systems Div.
ANALYTICAL INVESTIGATION OF VARIABLE CAMBER CONCEPTS Final Report, 15 Jan. - 15 Aug. 1971
A. Larry DeCosta, Kichio K. Ishimisu, Charles R. Pickrel, Douglas S. Miller, and Thomas A. Zierten Dec. 1971 171 p refs
(Contract N00014-71-C-0199)
(AD-740369; D-180-140013-1) Avail: NTIS CSCL 01/3

The principal objective of the investigation was to determine analytically the potential aerodynamic performance improvements that may be achieved through the use of variable camber. The feasibility study vonsidered initially systematic camber variations on two-dimensional airfoils representative of successful airfoils in widespread current usage and of a most promising research airfoil. The application of variable camber to each of these airfoils resulted in significant expansions of their performance envelopes. It was found that the Whitcomb Supercritical Airfoil achieved outstanding aerodynamic performance throughout the speed regime studied. Author (GRA)

N72-29013# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.
THE STUDY OF DISTRIBUTIVE PARAMETER SYSTEMS FOR FLIGHT CONTROL Yearly Report, 1 Jan. - 31 Dec. 1971
E. B. Lee 13 Apr. 1972 10 p refs
(Grant AF-AFOSR-1502-68)
(AD-740873; AFOSR-72-0918TR) Avail: NTIS CSCL 01/3

The research conducted during the last year has been primarily directed toward the development of new controller synthesis techniques for large modern Air Force aircraft. Control and modeling of systems with distributive parameters and time delays have been considered. The goal has been to evolve techniques which can be readily used in the design of controllers to reduce structural loading during wind gusts and in the design of controllers which can be used in configuring the vehicle to reduce appendage size and weight while maintaining satisfactory aircraft handling characteristics. An eventual goal is to have techniques of synthesis which take account of control capabilities during the original configuring of the vehicle that is, to enable design of the control system in parallel with the structure and propulsion systems. Author (GRA)

N72-29014# Instrument Pilot Instructor School, Randolph AFB, Tex.
CREW DUTIES, MODE AND FUNCTION STUDY
Donald L. Carmack Oct. 1971 28 p
(AD-740502; IPIS-TN-71-4) Avail: NTIS CSCL 01/2

Some of the basic problems associated with low visibility approaches can be traced to doubts concerning piloting roles when operating to lower minimums. Somewhat dependent on piloting procedures are the avionics and mode selection configurations which will not only integrate man and automatics, but provide the apparatus for control/monitoring and decision making. It is quite correct that an autopilot is an extremely important systems component. However, an autopilot in itself will not fulfill piloting requirements. What if the autopilot fails or softens in an axis. The crew must be prepared to take over the failed or softened component. This will only be possible if an adequate man/machine interface has been accomplished. Author (GRA)

N72-29015# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A MAINTENANCE MANHOUR SENSITIVITY MODEL FOR CARGO AIRCRAFT M.S. Thesis
Terry R. Little Mar. 1972 124 p refs
(AD-741410; GSA/SM/72-9) Avail: NTIS CSCL 15/5

A statistical study, based on one year's historical data, was made on the effects of certain policy changes on both cargo aircraft maintenance manhours and aircraft out-of-commission time. The results indicated that manhours were highly sensitive to flying hours, but not in constant proportion as implied in the generally used term, manhours/flying hour. Sortie length and number of landings per sortie have no apparent effects on manhours, judging from the sample data. It was further discovered that manhour changes may be expected if an aircraft is deployed either to Pacific Air Forces or Reserve/Guard units. Further manhours were found to be highly correlated with aircraft complexity as primarily measured by aircraft empty weight. Author (GRA)

N72-29016# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRELIMINARY DESIGN OF AN AIRCRAFT
B. T. Goroshchenko, A. A. Dyachenko, and N. N. Fadeev 10 Feb. 1972 404 p refs Transl. into ENGLISH from "Eskiznoe Proektirovanie Samoleta" 1970 p 1-332
(AD-741485; FTD-HC-23-753-71) Avail: NTIS CSCL 01/3

The book sets forth the fundamentals of elaboration of technical specifications for a new aircraft design, problems of the influence of geometrical and other parameters of the aircraft on its flight characteristics and stability indices (together with methods for approximate calculation of these characteristics and indices), and also the principles of layout selection, determination of the basic weight, geometrical, and structural characteristics, over-all configuration, trim, and airframe development for the preliminary design stage. In addition, the book presents an example of the application of the basic principles of preliminary aircraft design. Author (GRA)

N72-29017# Army Aeromedical Research Lab., Fort Rucker, Ala.
CRASH INJURY ECONOMICS: INJURY AND DEATH COSTS IN ARMY UH-1 ACCIDENTS IN FISCAL YEAR 1969
Armand E. Zilioli and Jay C. Bisgard Dec. 1971 37 p refs
(DA Proj. 3A0-62110-A-819)
(AD-741363; USAARL-71-18) Avail: NTIS CSCL 01/2

During fiscal year 69, there was a total of 546 major and minor noncombat aircraft accidents involving UH-1 type helicopters. The report presents an economic study of the 160 individuals with major injuries and 227 fatalities which occurred in 129 of these accidents. Minor injuries were not considered. Personnel costs of aircraft accidents were evaluated using hospitalization and convalescence times and costs, pay costs, replacement costs, funeral costs, death benefits and Veterans Administration and Social Security Administration benefits. These costs were computed using the least expensive method. Human costs, such as pain, suffering, deformity, or the loss of earning power are factors which are real costs but which cannot be determined. The total treatment time for the 160 injured individuals was 19,097 days. When considered on the basis of a 246 day work year, the total treatment time equaled 77.6 work years. Author

N72-29018# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A GRADIENT TECHNIQUE FOR DETERMINING IMPROVED AIRCRAFT TRAJECTORIES FOR REDUCING AIRCRAFT PROBABILITY OF KILL TO ANTI-AIRCRAFT GUN FIRE

M.S. Thesis
Floyd L. Cooper, Jr. Mar. 1972 69 p refs
(AD-741373; GAW/MC/72-4) Avail: NTIS CSCL 19/5

The problem is to develop a technique for predicting improved aircraft flight paths that simultaneously reduce the probability of the aircraft being killed by anti-aircraft gun (AAA) fire, and fly the aircraft to certain specified position and velocity vectors, both in and out of gun range. This study develops and demonstrates a gradient minimization technique called OPTAAA for solving this problem. OPTAAA utilizes the SIMFIND1 AAA attrition model, written by the Institute for Defense Analyses, as a subroutine for computing the aircraft probability of kill. OPTAAA is applied to three problems. One of the problems utilizes two-dimensional aircraft trajectories and results in a 39.7 percent reduction in probability of kill. The second and third problems utilize three-dimensional aircraft trajectories and result in a 17.7 percent and a 41.5 percent reduction, respectively, in probability of kill. Author (GRA)

N72-29019# American Nucleonics Corp., Woodland Hills, Calif.
COMPARISON OF UH-1C FLIGHT TEST DATA WITH MOSTAB-C SMALL PERTURBATION MATH MODEL Final Report
Arhtur J. Welch and Edward L. Warren Ft. Eustis, Va. Army Air Mobility Res. and Develop. Lab. Dec. 1971 116 p refs
(Contract DAAJ02-71-C-0023; DA Proj. 1F1-62204-A-A44)
(AD-740774; ANC-95R-1; USAAMRDL-TR-71-66) Avail: NTIS CSCL 20/4

The purpose of the work performed under this contract was to conduct a UH-1C model validation analysis. The model was obtained from Government-furnished MOSTAB-C computer data that defined the UH-1C stability and control derivatives at selected flight conditions. The reference data consisted of Government-furnished UH-1C helicopter flight test data. Overall, the MOSTAB-C data represented a fair first approximation to the actual vehicle dynamics. The MOSTAB-C data that was least representative of the actual vehicle response dynamics was the cross-coupling responses. Author (GRA)

N72-29020# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
CRITERIA FOR EXTERNALLY SUSPENDED HELICOPTER LOADS Final Report
Stanley J. Briczinski and George R. Karas Ft. Eustis, Va. Army Air Mobility Res. and Develop. Lab. Nov. 1971 211 p
(Contract DAAJ02-70-C-0021; DA Proj. 1F1-62203-A-435)
(AD-740772; SER-50731; USAAMRDL-TR-71-61) Avail: NTIS CSCL 01/3

The study was conducted to determine the dynamic effects of a helicopter external load combination by simulating flight using a computer. Design criteria for sling members and hard points of the system were also established. A computerized hybrid simulation of the coupled motion of a CH-54 helicopter and selected external loads was conducted in real time with a pilot in the loop on both fixed-base and moving-base simulators. The results of the study indicate that the dynamic load factors produced in sling elements and at hard points during a maneuver often exceed the normal load factor developed by the helicopter. Data is included for the various loads and maneuvers. GRA

N72-29021# Stanford Research Inst., Menlo Park, Calif.
SLANT RANGE VISIBILITY MEASUREMENT FOR AIRCRAFT LANDING OPERATIONS Final Report, 1 Apr. 1971 - 30 Apr. 1972
William Viezee, John Oblanas, and Ronald R. H. Collis Feb. 1972 94 p refs
(SRI Proj. 1148; AF Proj. 6670)
(AD-742359; AFCRL-72-0154) Avail: NTIS CSCL 01/2

A method of determining slant visibility by lidar observations from the ground during various degrees of fog and low cloud conditions was investigated in an experimental program at a coastal site. The emphasis of the study was on the operational aspects of landing aircraft in Categories I and II conditons, and the first concern was to ascertain whether a pilot might be expected to obtain visual reference from the critical heights of 200 ft and 100 ft respectively. This depends primarily upon the transmittance along the slant path from the cockpit to the ground. The air of the lidar observations was to determine the conditions of atmospheric transmittance aloft, with special reference to whether the appropriate minimum values are exceeded. Author (GRA)

N72-29022# Boeing Co., Seattle, Wash. Military Aircraft Systems Div.
ADVANCED INTEGRATED FIGHTER COCKPIT STUDY Final Draft
D. R. Zipoy, S. T. Premselaar, and N. A. Kopchick Wright-Patterson AFB, Ohio AFFDL Jun. 1971 49 p refs
(Contracts F33615-69-C-1544; F33615-70-C-1832)
(AD-741948; AFFDL-TR-71-57) Avail: NTIS CSCL 01/3

The report presents, in summary fashion, a general description of the work accomplished to date on the development of a concept for the crew station of an advanced tactical fighter aircraft of the 1980 time period. A composite mission profile and scenario are presented to define the operational requirements for the system concept. Airplane configuration and performance are described, and the characteristics and capabilities of the on-board avionics are summarized. A full-sized, single-place cockpit mockup and three basic interior configurations have been fabricated to reflect study results and to serve as evaluation tools. Author (GRA)

N72-29023# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINING STABILITY DERIVATIONS FROM FLIGHT TEST RESULTS WITH AID OF REGRESSION ANALYSIS
H. Friedrich 20 Jan. 1972 47 p refs Transl. into ENGLISH from Deutsch Ges. fuer Luft-und Raumfahrt E. V. (West Germany), 1969 p 1-44
(AF Proj. 139A)
(AD-741486; FTD-HT-23-662-71) Avail: NTIS CSCL 01/3

A static method is given for ascertaining stability derivative from the results of flight tests. The theory of the methods used, the so-called regression analysis is traced in detail. The necessary modifications are also reported with respect to practical performance and the computer program is explained in its basic outlines. In conclusion, discussion is entered into with relation to the experiments thus far collected with this evaluation method. Report is first made concerning the tests with the measured values from the flight simulator and finally report is made on the first experiments with results of actual flight tests from the Do 31 flight investigation. Author (GRA)

N72-29024# Army Agency for Aviation Safety, Fort Rucker, Ala.
PREPARATION OF A SYSTEM SAFETY PROGRAM PLAN FOR AVIATION SYSTEMS DEVELOPMENT Final Report
Mar. 1972 36 p ref
(AD-741364; USAAAVS-TR-72-8) Avail: NTIS CSCL 13/12

As an essential part of the Army aviation accident prevention program, System Safety is dedicated to :before the fact: elimination of hazards from aircraft systems by the application of management, science, and technology principles. Army attempts to apply the provisions of MIL-STD-882 in aircraft development programs indicates a significant gap between requirements at the standard and a practical safety program. The purpose of the report is to identify specific areas of concern which lie between the philosophical and the practical applications of system safety. GRA

N72-29025# Dayton Univ. Research Inst., Ohio.
METHOD FOR THE PREDICTION OF PERFORMANCE OF STOL HIGH LIFT SYSTEMS NEAR MAXIMUM LIFT COEFFICIENT Final Report, Jan. - Sep. 1971
Paul T. Bauer Wright-Patterson AFB, Ohio AFFDL Dec. 1971

54 p refs
(Contract F33615-70-C-1019; AF Proj. 1366)
(AD-740476; AFFDL-TR-71-169) Avail: NTIS CSCL 01/3

Potential flow and boundary layer methods are identified and developed for the analytic calculation of the performance of lift systems with significant flow separation. Particular emphasis is given to the use of the presented methods in the calculation of the flow field for a single airfoil in demonstration of their capability. A procedure for application to multiple element high lift systems is indicated. Special consideration is given to the representation of turbulent separating boundary layers and an empirical computational procedure has been developed where none had previously existed. The work presented herein provides a thorough basis on which to develop an accurate computer simulation model of high lift systems with significant flow separation. Author (GRA)

N72-29026# Naval Air Development Center, Warminster, Pa. Crew Systems Dept.
G PROTECTIVE TILTING AIRCRAFT SEATS Interim Report
Harald J. VonBeckh 15 Mar. 1972 57 p refs
(AD-741202; NADC-72063-CS) Avail: NTIS CSCL 01/3

Several tilting, supinating seats which have been tested in flight and on centrifuges are described and their biomedical adequacy assessed. Only those, which assure unrestricted visibility in all directions will be accepted by the pilots. This can be achieved by an adequate selection of the pivot points, and other design criteria which are synthesized. Concerted effort of designers, aeromedical investigators and last but not least - pilots is urged for the realization of such an integrated G protective man-machine system. Supinating seats should also be provided for the crew of winged reentry vehicles (Space-Shuttle). For the passengers multi-directional G protective systems with escape capabilities should be developed. Author (GRA)

N72-29027# Air Force Academy, Colo. Frank J. Seiler Research Lab.
OPTIMAL 3-DIMENSIONAL MINIMUM TIME TURNS FOR AN AIRCRAFT Final Report
Robert P. Humphreys, George R. Hennig, William A. Bolding, and Larry A. Helgeson May 1972 39 p refs
(AF Proj. 7904)
(AD-742266; SRL-TR-72-0006) Avail: NTIS CSCL 01/2

Using a 3-dimensional formulation for an aircraft's dynamics, the required controls for a minimum time-to-turn are calculated. Three controls are used: angle of attack, bank angle, and thrust. The minimum time-to-turn solutions are subject to varying terminal conditions on both flight path angle and heading angle. In general, the times for the turns are not greatly changed by varying thrust/weight ratios or the final flight path angle. Significant effects on the change in total energy, final altitude, final velocity and control histories are noted for variations of the above parameters. Solutions to the above are accomplished through the use of Miele's Sequential Gradient-Restoration Algorithm. Author (GRA)

N72-29028# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.
HELICOPTER DEVELOPMENT RELIABILITY TEST REQUIREMENTS
Lester R. Burroughs, Edwin Stolper, and Richard Hawkins Feb. 1972 52 p refs
(Contract DAAJ02-70-C-0040; DA Proj. 1F1-62203-A-143)
(AD-742248; SER-50710; USAAMRDL-TR-71-74) Avail: NTIS CSCL 01/3

The H-3 series helicopter program has been used to provide a basis for the trade-off studies. The test and service experience has been reviewed to provide a data bank on the performance of transmission and rotor system components and to determine modes and types of failures. The extent of correlation between failures during the initial test programs and those problem areas that were later detected during actual usage was investigated to determine the effectiveness of the test programs. Several changes have been advocated in both testing philosophy and the corresponding test techniques since the H-3 helicopter test program commenced. Various testing concepts have been considered and compared to develop a recommended test program for a single-rotor helicopter having a nominal gross weight of 15,000 pounds. Author (GRA)

N72-29029# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYSTEMS WITH A VARIABLE STRUCTURE AND THEIR USE IN FLIGHT-AUTOMATION PROBLEMS (COLLECTION OF ARTICLES)
B. N. Petrov and S. V. Yemelyanova 11 Feb. 1972 558 p refs Transl. into ENGLISH from Russian reports
(AD-742380; FTD-MT-24-981) Avail: NTIS CSCL 01/3

The collection examines the principles of the construction of a comparatively new class of the automatic control systems and their practical application in problems of providing the stability and stabilization of the motion of flight vehicles. A mathematical description of the behavior of the flight vehicles as control objects is given, algorithms of the control of complex objects are investigated, and methods of calculation of systems are developed. Considerable attention is given to problems of the obtaining of information about the state of the object to be controlled. A number of articles is devoted to the development of logic elements for the realization of the obtained control algorithms. Author (GRA)

N72-29030# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DESIGN OF A LONGITUDINAL FLIGHT CONTROL SYSTEM FOR A STOL TRANSPORT IN THE LANDING CONFIGURATION M.S. Thesis
Edwin L. Hamilton Mar. 1972 122 p refs
(AD-742314; GE/EE/72-13) Avail: NTIS CSCL 01/3

The longitudinal dynamics of a medium STOL transport are studied to determine the augmentation necessary to provide an acceptable longitudinal flight control system, and a flight control system is synthesized and evaluated. Wind tunnel data is analyzed and an operating envelope is defined. Longitudinal handling qualities of the unaugmented aircraft are compared to Air Force requirements, and design criteria are formulated. A longitudinal flight control system which utilizes parallel actuation of both elevator and direct-lift control spoilers through movement of the pilot's stick is synthesized using root locus techniques. The system is based upon control of the flight path. Author (GRA)

N72-29031# Systems Technology, Inc., Hawthorne, Calif.
PILOT EXPERIMENTS FOR A THEORY OF INTEGRATED DISPLAY FORMAT Final Report
Warren F. Clement, R. Wade Allen, and Dunstan Graham Oct. 1971 200 p refs
(Contract N00014-68-C-0443; NR Proj. 213-044)
(AD-742127; STI-TR-183-2; JANAIR-711107) Avail: NTIS CSCL 01/4

In support of a theory for manual control displays, and, in particular, for integrated displays, a series of two pilot experiments were performed to enlarge the data base for the theory. A single-axis tracking experiment was performed with two different controlled elements and four different display formats. The effects of display format were separately evaluated from task difficulty and task performance with a particular view toward quantification of the pilots: parafoveal perceptual ability. In the second experiment four different integrated displays were tested in a precision tracking task with a view toward quantifying the effect of integration in the display. Author (GRA)

N72-29911* Laboratorium fur Betriebsfestigkeit, Darmstadt (West Germany).
STATISTICAL ANALYSIS OF MISSION PROFILE PARAME-

TERS OF CIVIL TRANSPORT AIRPLANES
Otto Buxbaum *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 541-563 refs (For availability see N72-29895 20-32)
CSCL 20K

N72-29914* National Transportation Safety Board, Washington, D.C.
FATIGUE FAILURE OF METAL COMPONENTS AS A FACTOR IN CIVIL AIRCRAFT ACCIDENTS
William L. Holshouser and Ruth D. Mayner *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 611-630 (For availability see N72-29895 20-32)
CSCL 20K

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines, hydraulic, pneumatic and electrical systems; actuators, and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N72-29032*# Florida Univ., Gainesville.
A STUDY OF GAS SOLUBILITIES AND TRANSPORT PROPERTIES IN FUEL CELL ELECTROLYTES Semiannual Report, 1 Mar. - 31 Aug. 1971
R. D. Jr. Walker 1 Jun. 1972 32 p refs
(Grant NGL-10-005-022)
(NASA-CR-120984; SAR-12) Avail: NTIS HC $3.75 CSCL 10A

An analysis of the rate of heat generation on the dissolution of sparingly soluble gas in electrolytes was made, and it leads to the conclusion that the temperature changes to be expected are much too small to be measured with precision owing to the slowness of the gas dissolution. It appears that more accurate gas solubility measurements are the only real hope of improved precision in heats of solution and other thermodynamic properties. Author

N72-29033*# Techtran Corp., Glen Burnie, Md.
PHASE-BOUNDARY IMPEDANCE OF NOBLE METAL ELECTRODES IN THE REGION OF HYDROGEN ADSORPTION. 1: ACTIVATED PLATINUM ELECTRODES
M. Breiter, H. Kammermaier, and C. A. Knorr Washington NASA Aug. 1972 25 p refs Transl. into ENGLISH from Z. Elektrochem (Weinheim, West Ger.), v. 60, no. 1, 1956 p 37-47
(Contract NASw-2037)
(NASA-TT-F-14365) Avail: NTIS HC $3.25 CSCL 10A

Comparisons using direct and alternating currents, high and low voltages, and various ranges are described and charted for atomic and molecular hydrogen with the linear proportions of the functions. Author

N72-29034*# Gulf General Atomic, San Diego, Calif.
STUDIES OF THERMIONIC MATERIALS FOR SPACE POWER APPLICATIONS Summary Report, 1 Aug. 1969 - 7 Dec. 1970
20 Jul. 1971 110 p refs
(Contract NAS3-8504; Proj. 552)
(NASA-CR-72947; Gulf-GA-11035) Avail: NTIS HC $7.50 CSCL 10A

Service life tests of LC-8 and LC-9 carbide-fueled thermionic converters are discussed. Post operational tests of the converters to show emitter diametric change, microstructures of cladding and fuel, and analysis of fuel composition are described. The fabrication and performance of high temperature thermocouples used in the test procedures are included. Author

N72-29035# British Aircraft Corp. (Operating) Ltd., Bristol (England). Electronics and Space System Group.
A STUDY OF ADVANCED SOLAR ARRAY DESIGN Final Report, 1 Feb. - 19 Jun. 1970
D. W. Mann Sep. 1971 113 p refs
(Contract ESTEC-623/68)
(ESRO-CR(P)48) Avail: NTIS HC $7.75

The completion of the qualification and acceptance test programs, carried out on two demonstration models of a rolled flexible solar array is discussed. The development program is summarized, and recommendations for further development are made. ESRO

N72-29036# GTE Labs., Inc., Bayside, N.Y.
LITHIUM BATTERY WITH INORGANIC ELECTROLYTE Quarterly Progress Report, 1 Nov. 1971 - 29 Feb. 1972
James J. Auborn, Kenneth French, and Adam Heller Apr. 1972 14 p refs
(Contract DAAB07-72-C-0060)
(AD-741351; ECOM-0060-1) Avail: NTIS CSCL 10/3

Phosphorous oxychloride, a covalent inorganic liquid, has been proposed as a solvent for an inorganic electrolyte electrochemical cell employing a lithium anode. The properties of this solvent were investigated. Lithium metal is stable to attack by phosphorous oxychloride, even at its boiling point 105 C. The solvent is compatible with strong oxidizing agents including chlorine, bromine, oxygen (on catalysts) and sulfur. The investigation was undertaken to determine the feasibility of a lithium battery based on a phosphorous oxychloride solvent electrolyte and to define the limiting operating characteristics to be expected from such a battery. Author (GRA)

N72-29037# Army Foreign Science and Technology Center, Charlottesville, Va.
SCIENTIFIC AND TECHNICAL CONFERENCE OF THE INSTITUTE OF ELECTROMECHANICS
N. V. Vartanyan 10 Nov. 1971 12 p Transl. into ENGLISH from Elektrotekhnika (Moscow), no. 10, 1970 p 58-60 Conf. held at Leningrad, Jun. 1969
(AD-741047; FSTC-HT-23-1581-71) Avail: NTIS CSCL 10/2

The June, 1969, Scientific and Technological Conference of the Institute of Electromechanics in Leningrad was organized in the following sections and subsections: A section on large electric machines with four subsections on magnetic fields, loss parameters and heating problems; Ventilation problems; Problems of mechanical calculations; Electric machine diode systems with frequency control; Synchronous compensators; a section of DC machines; a section on systems for excitation of synchronous machines and static power converters; a technical and economic section; a section on low power electric machines; a section on quality and reliability; a section on cryogenic electrical engineering equipment and MHD devices with two subsections on cryogenic equipment and low temperature plasma generators and high current arc generators. Author (GRA)

N72-29038# Electro-Optical Systems, Inc., Pasadena, Calif.
A 20 WATT-HOUR PER POUND REGENERATIVE FUEL CELL Final Report, 22 Jun. 1970 - 22 Dec. 1971
Raymond L. Costa and Scott S. Tomter Wright-Patterson AFB, Ohio AFAPL Mar. 1972 182 p
(Contract F33615-70-C-1671; AF Proj. 3145)
(AD-740598; EOS-4058-FR; AFAPL-TR-72-18) Avail: NTIS CSCL 10/2

The electrolytically regenerative fuel cell is an electrochemical energy storage device, wherein the energy density per unit weight substantially exceeds present acceptable power sources. The report is concerned with a cylindrical regenerative hydrogen oxygen fuel cell which is a basic electrochemical cell serving the dual function of a primary fuel cell and a water electrolysis cell. It was demonstrated that regenerative fuel cells of the design described are capable of cyclical storage and release of 20 watt-hours of electrical energy per pound of energy storage system. The report briefly discusses the design and then

presents environmental test data on its operating performance.
Author (GRA)

N72-29039# Energy Research Corp., Bethel, Conn.
SECONDARY ZINC-OXYGEN BATTERIES Semiannual Report
Martin Klein Mar. 1972 47 p refs
(Contract DAAB07-71-C-0249)
(AD-740234; ECOM-0249-1) Avail: NTIS CSCL 10/3

The discussed secondary zinc-oxygen battery is based on the concept of using single sealed cylindrical cells in which the active electrodes and stored oxygen are contained. The cylindrical cell container serves as the pressure vessel for the stored oxygen. The zinc electrode is sandwiched between two layers of inorganic separator material containing electrolyte bound in the pores. Investigations have centered on the use of a bifunctional oxygen electrode that is used in both the charge and discharge mode. Individual test electrodes have been cycled up to 200 times. A design analysis of a 25AH cell based on the experimental results show that single cells will be capable of 60WH/lb and 2.7WH/cu in at 750 psi gas storage.
Author (GRA)

N72-29040# Army Foreign Science and Technology Center, Charlottesville, Va.
METHOD OF DETERMINING THE THERMOELECTRICAL QUALITY FACTOR OF THE THERMOBATTERY
I. A. Rezgol 28 Jul. 1971 7 p Transl. into ENGLISH from article published by Comm. of Patents and Inventions at the Council of Ministers (USSR)
(AD-741519; FSTC-HT-23-1439-71) Avail: NTIS CSCL 10/2

The scope of the invention concerns the transformation of thermal energy into electrical energy. A well known method of determining the quality factor of the thermoelectrical thermobattery results in taking separate measurements of thermoelectrical parameters. The measurement of each of these characteristics becomes a tedious and time consuming process, especially in the determination of heat conductivity. The proposed method differs by the fact that the temperature measurements at the thermojunctions and the output voltage of the thermobattery in the operational conditions, with an external load and under no load conditions, are carried out under constant heat current.
Author (GRA)

N72-29041# Army Foreign Science and Technology Center, Charlottesville, Va.
THE PRESENT AND FUTURE OF FUEL CELLS
V. S. Bagotskii and A. M. Skundin 1972 12 p Transl. into ENGLISH from Khimiya v Shkole (USSR), no. 3, 1970 p 10-16
(AD-741522; FSTC-HT-23-1569-71) Avail: NTIS CSCL 10/2

The operation of a fuel cell is briefly described, and the chemical reactions upon which the production of electricity is based are outlined. Possible applications of fuel cells in power engineering are also discussed. Author (GRA)

N72-29042# American Univ., Washington, D.C.
RESEARCH ON ELECTROCHEMICAL ENERGY CONVERSION SYSTEMS Final Report
Robert T. Foley, Daryl H. Bomkamp, and Charles D. Thompson Jan. 1972 64 p refs
(Contract DA-44-009-AMC-1386(T); DA Proj. 1T0-61102-A-34-A)
(AD-740210; Rept-12) Avail: NTIS CSCL 10/3

The research on electrochemical energy conversion systems has involved work on three tasks; high energy galvanic cells, the mathematical analysis of electrochemical energy conversion processes, and exploratory research. The investigation of high energy galvanic cells has dealt with two problems; the first, the electroreduction of benzofuroxan in organic electrolytes and, the second, the feasibility of the air electrode in organic systems. In connection with the feasibility study of the air electrode the solubility of oxygen was measured in four organic solvents and two organic electrolytes. The mathematical analysis of energy conversion systems dealt with the development of velocity-acceleration profiles applicable to military vehicle propulsion. Exploratory research dealt with solid proton conductors.
Author (GRA)

N72-29043# Tyco Labs., Inc., Waltham, Mass.
A STUDY OF THE DEGRADATION OF PLATINUM BLACK FUEL CELL CATHODES Interim Technical Report
P. A. Malachesky, C. Leung, and H. Feng Mar. 1972 37 p refs
(Contract DAAK02-71-C-0380; DA Proj. 1T0-61102-A-34-A)
(AD-742263; C-154; ITR-1) Avail: NTIS CSCL 07/4

The report deals with a study of the mode of cathode electrocatalyst degradation in the H2-air phosphoric acid matrix fuel cell. BET, X-ray line broadening, and pore-size distribution techniques have been used to determine the degree of catalyst recrystallization. Sintering of dry platinum black in air at 100 - 150 C leads to an initial rapid loss of surface area (within twenty-four hours), followed by a more gradual decrease to 43 plus or minus 2% of the original surface area after 500 hours independent of temperature. X-ray line broadening, however, shows no observable increase in average particle size corresponding to this surface area decrease. This indicates that the loss of surface area may be the result of a coalescence of crystallites with no effective change in average grain size. Sintering of dry Teflon-bonded platinum black electrode material in air was also conducted. Preliminary results of electrochemical testing in an 85% phosphoric acid electrolyte at these elevated temperatures have indicated that there may be an effect of electrolyte on the observed surface area decreases.
Author (GRA)

N72-29044# Mallory Battery Co., Tarrytown, N.Y.
LOW TEMPERATURE Hgo-Zn BATTERY FOR TRANSCEIVER APPLICATIONS Final Report, 26 May 1969 - 30 Nov. 1971
Robert H. Kelsey, H. Y. Kang, M. L. B. Rao, F. Fagan, and J. C. Hoffman Apr. 1972 88 p
(Contract F33615-69-C-1832; AF Proj. 3145)
(AD-741838; AFAPL-TR-72-6) Avail: NTIS CSCL 10/3

The report describes the work performed to improve the low temperature performance of zinc-mercuric oxide batteries for transceiver applications. Described is a cell employing two anode and depolarizer parts arranged as nested concentric annular cylinders with interposed separator and absorbent layers as prewound tubes. Maximum electrode surface area was thus developed. A non-woven mat of polyamide (nylon) fibers was selected as an absorbent, and four acceptable separator materials were screened from a group of fifteen, the final selection depending on material adaptation to cell configuration. The cells design and performance are examined. Author (GRA)

N72-29045# Army Foreign Science and Technology Center, Charlottesville, Va.
THERMOELECTRIC GENERATORS
A. S. Okhotin, A. A. Efremov, V. S. Okhotin, and A. S. Pushkarskii 22 Mar. 1972 369 p refs Transl. into ENGLISH of the publ. "Termoelektricheskiye generatory" Moscow, 1971 p 3-288
(AD-741858; FSTC-HT-23-1023-72) Avail: NTIS CSCL 10/2

The book is devoted to various aspects of the problem of thermoelectric conversion to thermal energy into electric. Examined are physico energetic principles of thermoelectricity, the present state of physics of the thermoelectric process, properties of semi conducting materials, various methods to calculate simple and complex thermoelectric construction. Described are thermoelectric generators of various types, designs and their purpose.
Author (GRA)

N72-29046# Army Foreign Science and Technology Center, Charlottesville, Va.
DOUBLE-MIRROR SOLAR ENERGY CONCENTRATORS

USING NICKEL PARABOLIC REFLECTORS
G. Ya. Umarov, A. K. Alimov, Dzh. V. Alavutdinsov, and V. N. Zakirova 29 Jan. 1972 8 p refs Transl. into ENGLISH from Geliotekh., Atad. Nauk Uzb. SSR (USSR), no. 6, 1970
(AD-741880; FSTC-HT-23-1004-72) Avail: NTIS CSCL 20/6

A double-mirror system consisting of two concave mirrors significantly increases maximum flux density and the equilibrium temperature of an absolutely black body. One consisting of concave and convex parabolic mirrors has little decrease in maximum flux density and adjustment power, whereas the system's angle of opening is significantly decreased, improving efficiency of the device. Author (GRA)

N72-29047# Argonne National Lab., Ill.
LITHIUM/CHALCOGEN SECC IDARY CELLS FOR COMPONENTS IN ELECTRIC VEHICULAR PROPULSION GENERATING SYSTEMS Interim Technical Summary Report No. 5, 23 May - 22 Nov. 1971
William J. Walsh, Eddie C. Gay, John D. Arntzen, Elton J. Cairns, Donald S. Webster, and J. E. Kincinas Nov. 1971 43 p refs
(DA Proj. 1T6-62705-A-012)
(AD-741801; Rept-5) Avail: NTIS CSCL 10/3

The research concerned the construction of lithium/chalcogen secondary cells for components in electric vehicular propulsion power generating systems. The report describes the performance of an unsealed cell (Cell No. 73). Cell No. 73, a liquid-electrolyte Li/LiF-LiCl-KCl/(S-Se) cell has consistently achieved a capacity density of greater than 0.30 A-hr/sq cm at the 1-hr rate. It is concluded that the hybrid vehicle peak power requirements can be readily achieved with lithium/chalcogen cells. The S-Se cathode alloy used in Cell No. 73 resulted in better electrical performance than was achieved in previous cells using S-Se-Tl alloys. Author (GRA)

N72-29048# Sundstrand Aviation-Rockford, Ill.
DETERMINATION OF THE OPTIMUM FLUID AND SYSTEM VARIABLES FOR .5-5 KWE RANKINE CYCLE POWER SYSTEMS Final Report, 1 Feb. - 30 Sep. 1971
David B. Wigmore and Richard E. Niggemann Feb. 1972 258 p refs
(Contract DAAK02-71-C-0142)
(AD-741835; SA/AER-642) Avail: NTIS CSCL 20/13

A computerized mathematical model of Rankine cycle performance analysis, component design, fluid thermodynamic and thermophysical property evaluation integrated with a multivariable optimization technique, was used to describe the sensitivity of the major system variables of initial cost weight, volume and performance over a .5 to 5 kwe power range to the independant fluid and system variables. These independant variables were automatically and simultaneously operated upon in a continuous manner to effect minimization of a criterion function defined as a weighted summation of the major system variables. Author (GRA)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N72-29049*# Bryn Mawr Coll., Pa.
STIMULUS CONTROL IN PIGEONS AFTER EXTENDED DISCRIMINATIVE TRAINING
Matthew Yarczower [1972] 15 p refs
(Grant NGR-39-018-002)
(NASA-CR-127772) Avail: NTIS HC $3.00 CSCL 06C

The effects of amount of training on conditioned inhibition and on the degree of stimulus control were studied using pigeons. The ability of an S- associated with non-reinforcement of suppress positive reinforced behavior was acquired very rapidly during discriminative training. Increased S+, S- training appeared to weaken this conditioned inhibitory effect while at the same time more S+ training apparently increased the amount of external inhibition (non-conditioned inhibition) of positively reinforced behavior by a novel stimulus. Behavioral contrast and incremental generalization gradients along the S-dimension (inhibitory dimensional control) were absent at all stages of training. Behavioral contrast and inhibitory dimensional control are therefore not necessary concomitants of conditioned inhibition by an S-. A new method of assessing the suppressive effects of stimuli during generalization tests was described.
Author

N72-29050*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A PRELIMINARY INVESTIGATION OF THE ENVIRONMENTAL CONTROL AND LIFE SUPPORT SUBSYSTEMS (EC/LSS) FOR ANIMAL AND PLANT EXPERIMENT PAYLOADS
Hubert B. Wells 15 May 1972 69 p refs
(NASA-TM-X-64678) Avail: NTIS HC $5.50 CSCL 06F

A preliminary study of the environmental control and life support subsystems (EC/LSS) necessary for an earth orbital spacecraft to conduct biological experiments is presented. The primary spacecraft models available for conducting these biological experiments are the space shuttle and modular space station. The experiments would be housed in a separate module that would be contained in either the shuttle payload bay or attached to the modular space station. This module would be manned only for experiment-related tasks, and would contain a separate EC/LSS for the crew and animals. Metabolic data were tabulated on various animals that are considered useful for a typical experiment program. The minimum payload for the 30-day space shuttle module was found to require about the equivalent of a one-man EC/LSS; however, the selected two-man shuttle assemblies will give a growth and contingency factor of about 50 percent. The maximum payloads for the space station mission will require at least a seven-man EC/LSS for the laboratory colony and a nine-man EC/LSS for the centrifuge colony. There is practically no room for growth or contingencies in these areas. Author

N72-29051# Joint Publications Research Service, Arlington, Va.
SPACE BIOLOGY AND MEDICINE, VOLUME 6, NO. 3, 1972
3 Aug. 1972 143 p refs Transl. into ENGLISH of Kosm. Biol. Med. (USSR), v. 6, no. 3, May-Jun. 1972 p 3-90
(JPRS-56675) Avail: NTIS HC $9.25

Medical and biological research is reported on physiological and psychological aspects of manned space flight. Studies are aimed at guaranteeing safety on long flights and reliability of the human component in the man-spaceship system. For individual titles, see N72-29052 through N72-29072.

N72-29052 Joint Publications Research Service, Arlington, Va.
MATHEMATICAL MODEL OF A TWO-COMPONENT ALGAL-BACTERIAL BIOCENOSIS
N. S. Abrosov and B. G. Kovrov *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 1-11 refs (For availability see N72-29051 20-04)

A mathematical model of an algal-bacterial biocenosis developing as a result of nonsterile Chlorella cultivation is reported. The model takes into account living and dead Chlorella cells and concomitant microorganisms, carbon dioxide, mineral components, oxygen, organic substances, light energy and the basic processes involved in transformation of these components. The model is based on the description of an object by means of systems with limiting factors (L-systems). The model makes it possible to trace changes of all important components in the biocenosis, to define the parameters that cannot be readily measured experimentally, and to ascertain the principal regularities in development of the investigated biocenosis. Author

N72-29053 Joint Publications Research Service, Arlington, Va.
STATUS OF CALCIUM METABOLISM IN THE CALCIFIED TISSUES OF RATS DURING PROLONGED HYPODYNAMIA AND THYREOCALCITONIN ADMINISTRATION
A. I. Volozhin, P. V. Vasilyev, N. N. Uglova, and V. Ye. Potkin *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 12-19 refs (For availability see N72-29051 20-04)

The influence of 5-, 10-, 20-, 40- and 60-day hypodynamia and thyreocalcitonin administration on the resorption rate of Ca-45 given 70 days before the exposure was investigated in experiments on 180 albino rats. In comparison with the controls the hypolinetic exposure decreased the increment in the weight of skeletal bones to a considerable extent. Daily injections of 5 micrograms of thyreocalcitonin in combination with polyvinyl pyrrolidone to nonrestrained rats also caused a decrease in the Ca-45 level in their calcified tissues. Injections of the drug to restrained animals exerted an opposite effect: the renovation rate of the nonreadily exchangeable fraction increased in comparison with that in animals exposed to hypodynamia alone. The drug exerted an insignificant effect on the growth rate of skeletal bones in restrained rats.

N72-29054 Joint Publications Research Service, Arlington, Va.
EFFECT OF HYPOXIA ON THE SKELETAL MUSCLES OF RATS DURING HYPOKINESIA
V. V. Portugalov, Ye. I. Ilina-Kakuyeva, and V. I. Starostin *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 20-23 refs (For availability see N72-29051 20-04)

Experimental rats were exposed simultaneously to 14- and 30-day hypokinesia and hypoxia of 405.09 mm Hg. It was demonstrated that hypoxia did not prevent their development of morphologic and metabolic changes which can be observed during hypokinesia. Author

N72-29055 Joint Publications Research Service, Arlington, Va.
TOXICOLOGICAL EVALUATION OF SOME SYNTHETIC MATERIALS USED IN SEALED ENCLOSURES
G. I. Solomin, G. M. Gorban, and V. A. Shchirskaya *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 24-29 refs (For availability see N72-29051 20-04)

Three polymers used extensively in sealed enclosures were subjected to a toxicological evaluation. When exposed to a temperature of 80-85 deg they released products at concentrations which caused functional changes in white rats and white mice which inhaled them for two hours. From the toxicological point of view the most important changes were induced by AK-20-A nitroglue, which therefore cannot be recommended for further use in these environments. The other two materials released no substances which were harmful and can be employed in the interiors of small sealed rooms. Author

N72-29056 Joint Publications Research Service, Arlington, Va.
SANITARY-HYGIENIC EVALUATION OF THE EXTRACTION METHOD FOR REGENERATING WATER FROM A CONDENSATE OF ATMOSPHERIC MOISTURE c05
Yu. Ye. Sinyak, L. A. Kuznetsova, M. I. Shikina, A. G. Filchakov, and V. V. Krasnoshchekov *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 30-34 refs (For availability see N72-29051 20-04)

Water regenerated from an atmospheric condensate by extraction with higher amines and alkyl phosphonic acids was subjected to sanitary-hygienic and biomedical evaluations. After additional sorption purification water regenerated in this way contained no toxic impurities, thus completely satisfying the sanitary-hygienic requirements. Author

N72-29057 Joint Publications Research Service, Arlington, Va.
SOME METHODS FOR TRANSPORTING LIQUID WASTES OF THE VITAL FUNCTIONS OF A CREW AND SANITARY-WASTE WATER DURING SPACE FLIGHTS c05
V. P. Yefimov and V. A. Frolov *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 35-39 refs (For availability see N72-29051 20-04)

Different procedures for the transport of liquid wastes and waste water during weightlessness are discussed. A diagram of liquid transport in the waste management system of the Vostok and Voskhod spacecraft is described. A brief analysis of the operation of American waste management systems makes it possible to evaluate their possible application in long term space flights. Diagrams of gas-fluid separators which operate on capillary forces for transporting the fluid and separating it from the gaseous phase are included. Author

N72-29058 Joint Publications Research Service, Arlington, Va.
EFFECT OF A HYPEROXIC ATMOSPHERE ON RAT TOLERANCE TO ACUTE CARBON MONOXIDE EXPOSURE
B. I. Abidin, V. I. Belkin, A. N. Malkuta, and G. D. Yukhnovskiy *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 40-42 refs (For availability see N72-29051 20-04)

It is demonstrated that the 30-day exposure of white male rats to a hyperoxic atmosphere (45 percent O2) at normal barometric pressure caused a delay in their body weight increment and a decrease in their oxygen consumption. This exposure exerts no real influence on animal tolerance of acute exposure to carbon monoxide. Author

N72-29059 Joint Publications Research Service, Arlington, Va.
EFFECT OF PROLONGED GAMMA IRRADIATION ON THE FUNCTIONAL ACTIVITY OF LEUKOCYTES
E. S. Zubenkova *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 43-48 refs (For availability see N72-29051 20-04)

The functional activities of blood and bone marrow cells of 30 dogs exposed for three years to gamma irradiation in different doses (0.06, 0.2 and 0.4 rad per day) are presented. Functional activity was evaluated by measuring the osmotic resistance of leukocytes and by determining the viability of granulocytes during supravital staining. In irradiated animals the osmotic resistance of leukocytes decreased and the changes were detected a year after onset of the exposure. Specific investigations revealed that the dropoff in functional activity of cells occurred in the bone marrow. Author

N72-29060 Joint Publications Research Service, Arlington, Va.
LABYRINTHAL REACTIONS OF DOGS DURING PROLONGED CHRONIC IRRADIATION
P. I. Kumets *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 49-54 refs (For availability see N72-29051 20-04)

A study of the functional state of the vestibular analyzer in dogs during a three-year chronic irradiation (a total dosage of 188.5 rad per year) revealed phasic and transient changes in the excitability and reactivity of the cupular-endolymphatic system. Author

N72-29061 Joint Publications Research Service, Arlington, Va.
NORMAL AUTOANTIBODIES AS A PROTECTIVE ANTIRADIATION FACTOR
N. N. Klemparskaya *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 55-63 refs (For availability see N72-29051 20-04)

Experiments carried out on 1,410 white common female mice exposed to Co-60 gamma irradiation Cs gamma irradiation and X-irradiation to provide a total uniform dose of 900 R have demonstrated that the lower the dose rate, the higher is the content of normal antibodies in the blood and organs of the animals during the first 30 minutes after the exposure. Irradiation with a dose of 900 R, imparted in two portions with a one hour interval, also increases the occurrence of normal autoantibodies in the blood. Accordingly, there is a linear correlation between the dose rate, the severity of the damage and intensity of the autoimmune process during the peak of radiation sickness. Mobilization of normal autoantibodies in an organism irradiated with low dose rates exerts a protective effect and increases its radioresistance. Author

N72-29062 Joint Publications Research Service, Arlington, Va.
INCORPORATION OF METHIONINE-S-35 INTO THE PROTEINS OF DIGESTIVE SYSTEM ORGANS OF RABBITS EXPOSED TO IRRADIATION AND VIBRATION
A. V. Krillicheva, R. I. Yuy, V. I. Denisov, and L. S. Prikhodko *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 64-68 refs (For availability see N72-29051 20-04)

Protein metabolism changes in the digestive system organs of month-old rabbits in response to irradiation, acceleration, and vibration transpires in the following principle forms: (1) a predominance, at early times after exposure, of the effects of irradiation and vibration, exerting an independent reciprocal influence, and at later times, the acceleration effect; (2) absence of significant effects at early times after exposure, whereas at later times the appearance of all the principle effects and the effect of second order interaction is observed; and (3) absence of significant effects at early times after exposure, and later appearance of the acceleration effect and also the effects of interaction between irradiation and vibration. Author

N72-29063 Joint Publications Research Service, Arlington, Va.
THE PROBLEM OF ARTIFICIAL GRAVITATION FROM THE VIEWPOINT OF EXPERIMENTAL PHYSIOLOGY
Ye. M. Yuganov and M. D. Yemelyanov *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 69-74 refs (For availability see N72-29051 20-04)

On the basis of experimental investigations on small laboratory animals during flights along Keplerian trajectories it was concluded that an acceleration of 0.3 g is the minimum effective value required to generate artificial gravity on space missions. Vestibular reactions, motor activity and the biopotentials of skeletal muscles of small laboratory animals were used as criteria. A study of adaptive processes of man long exposed to rotation helped in establishing the threshold parameters with respect to the use of artificial gravity. Author

N72-29064 Joint Publications Research Service, Arlington, Va.
MAN'S TOLERANCE TO ACCELERATIONS AFTER PROLONGED EXPOSURE TO CONDITIONS SIMULATING WEIGHTLESSNESS
A. S. Barer, Ye. I. Sorokina, and K. I. Murakhovskiy *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 75-80 refs (For availability see N72-29051 20-04)

Data on how men can tolerate long applied transverse accelerations (65 to 78 deg) after prolonged exposure to simulated weightlessness were derived semiempirically. The results are summarized in a graph on which accelerations are plotted as a function of exposure duration. It is assumed that following prolonged exposure to weightlessness (seven-60 days) space pilots will tolerate a l g effect worse than re-entry decelerations. Author

N72-29065 Joint Publications Research Service, Arlington, Va.
EFFECT OF PSYCHOTROPIC SUBSTANCES ON MAN'S TOLERANCE TO ACCELERATIONS
P. V. Vasilyev, V. Ye. Belay, R. A. Vartbaronov, and G. D. Glod *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 81-90 refs (For availability see N72-29051 20-04)

The influence of psychotropic substances (stimulants and tranquilizers) on human tolerance to accelerations was studied on five volunteers in 25 experimental runs. The effectiveness of these drugs was evaluated with respect to hemodynamics and performance in comparison with the control experiments. The administration of a combination of stimulants (centedrin 0.01 + securinin 0.002) reduced the adverse effect of accelerations: hemodynamic indices changed to a lesser degree, compensation of intracranial and retinal circulation improved, and work capacity decreased to a lesser degree. Administration of a tranquilizer did not affect the level of acceleration-induced hemodynamic shifts, although there was a decrease in the unfavorable stress effect on performance of the test subjects. Author

N72-29066 Joint Publications Research Service, Arlington, Va.
INVESTIGATION OF HEMODYNAMICS WITH EXPOSURE TO DECOMPRESSION AND ACCELERATIONS
P. M. Suvorov, V. G. Voloshin, L. N. Dyachenko, and V. F. Krivets *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 91-98 refs (For availability see N72-29051 20-04)

Compared is the hemodynamic state of man exposed to lower body negative pressure of -50 and -70 mm Hg and +G sub z accelerations of 3 to 7 g for 30 sec. In addition to certain similarities in the hemodynamic changes induced by LBNP and accelerations, the studies demonstrated definite significant differences. During LBNP there was no gradient of arterial pressure between trunk and head vessels. The elevation level of arterial tone was about twice as low during LBNP than during an exposure to accelerations. Application of LBNP, especially of -70 mm Hg, induced not only a type of vascular decompensation, but also cardiac and cardiovascular types involving a heart rate decrease. Author

N72-29067 Joint Publications Research Service, Arlington, Va.
CHANGE IN THE FUNCTIONAL STATE OF ANALYZERS OF FLIGHT CREWS DURING PROLONGED FLIGHTS
E. V. Bondarev, V. A. Yegorov, and O. F. Zakharova *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 99-102 (For availability see N72-29051 20-04)

During prolonged flights the functional states of analyzers of airline crew members undergo changes under the influence of adverse factors that to a certain degree are similar to spaceflight factors. The rate of information processing and the carrying capacity based on the speed and accuracy of responses to signals (acoustic and optical stimuli) decline most significantly. The responses to vibrotactile signals remain virtually unchanged. The degree of the decrease in these indices depends greatly on crew activity. Author

N72-29068 Joint Publications Research Service, Arlington, Va.
PSYCHOLOGICAL PRINCIPLES OF ACTIVE REST DURING PROLONGED SPACE FLIGHTS
G. M. Zarakovskiy and S. L. Rysakova *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 103-108 refs (For availability see N72-29051 20-04)

Several hypotheses concerning the psychophysiologic laws which underlie active rest are discussed. This type of rest is regarded as a manifestation of antihomeostatic tendencies which are specific for the human psychic sphere. The positive emotional effect of active rest is dependent on formal-information characteristics and the correspondence of their content to the interests of the particular individual. It has been postulated that with an increase in flight duration the importance of the first component will increase. This hypothesis was confirmed in a 70-day experiment simulating space flight with the use of such means of active rest as musical productions and motion picture films. Author

N72-29069 Joint Publications Research Service, Arlington, Va.
MORPHOLOGICAL-FUNCTIONAL CHANGES IN THE ENDOCRINAL SYSTEM ACCOMPANYING OXYGEN STARVATION
In its Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 109-120 refs (For availability see N72-29051 20-04)

Data on the influence of oxygen starvation on the structure and functioning of a number of endocrinal organs are discussed. The state of oxygen starvation in animals is accompanied by morphological and functional shifts on the part of the endocrinal system. Under these conditions the functional activity of the suprarenals is increased, whereas the activity of the thyroid gland and testes is reduced. It is postulated that the reasons for this selectivity in impairments in functioning of individual peripheral endocrinal organs during hypoxia are morphological-functional changes in the central nervous system and nuclear formations of the hypothalamic region. Author

N72-29070 Joint Publications Research Service, Arlington, Va.
FUNCTIONAL RELIABILITY OF THE BIOLOGICAL LINK IN A LIFE SUPPORT SYSTEM
I. A. Shvytov *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 121-128 refs (For availability see N72-29051 20-04)

The problems involved in reliability of functioning of the biological component in a life support system are disscussed. The case of using a microbial population cultivated in a chemostat as such a component is described. The duration of reliability of this system is ascertained and the formulas to be used in calculating the upper and lower limits of its reliability are given. Author

N72-29071 Joint Publications Research Service, Arlington, Va.
METHOD FOR COMPUTING SOME PARAMETERS FOR THE ENVIRONMENTAL CONTROL SYSTEM OF A SPACESUIT **c05**
I. P. Abramov *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 129-136 refs (For availability see N72-29051 20-04)

A procedure for selecting the optimum atmospheric parameters for a spacesuit before extravehicular operations is given. A method for calculating oxygen consumption to ensure the required atmosphere is described. When determining the parameters it is necessary to know the initial and final oxygen contents in the spacesuit, as well as the oxygen free volume and absolute pressure during ventilation. The nomogram to be used in calculating the specifications for the atmosphere replacement system and the reliability of the full pressure suit is presented. Author

N72-29072 Joint Publications Research Service, Arlington, Va.
FACTORS AFFECTING THE BIOLOGICAL EFFECTIVENESS OF PROTONS **c29**
M. F. Lomanov *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 137-140 refs (For availability see N72-29051 20-04)

The conditions for electron equilibrium in a beam of protons and their influence on the RBE are studied; considered is the equality between the numbers of secondary electrons generated and annihilated in an elementary volume of the medium. A disruption of electron equilibrium can occur if the radius of the prcton beam is less than the maximum path R sub 1 of the secondary electrons; usually this occurs in beams passing through air. Such beams can be arbitrarily called narrow and for them no electron equilibrium will be observed with transition from the air to a dense medium even with an equality of the stopping powers. In addition, the emergence of a narrow beam from a dense medium into the air involves a loss of electrons due to a decrease in backscattering. Electron equilibrium is disrupted in a broad beam as well when there is a change in the stopping power of the medium. Author

N72-29073*# National Aeronautics and Space Administration, Washington, D.C.
US-USSR SPACE BIOLOGY REPORT
Richard Friedman 1 Aug. 1972 4 p
(NASA-News-Release-72-157) Avail: NASA Scientific and Technical Information Facility, P. O. Box 33, College Park, Md. 20740 CSCL 06B

The recommendations of the Joint Working Group on Space Biology and Medicine are reported. The exchange of information for the U.S. included the pre- and postflight medical requirements and flight crew health stabilization program for Apollo 16. The U.S.S.R. presentations detailed the medical findings of the Soyuz/Salyut mission, including the postflight autopsy results. The causes of death of the cosmonauts were the occurrence of hypoxia and gaseous embolism. A significant development resulting from the meeting was the agreement that the Joint Working Group strive toward the development of common pre- and postflight medical examination procedures for flight crews for direct comparison of U.S. and U.S.S.R. data. F.O.S

N72-29074# Civil Aeromedical Inst., Oklahoma City, Okla.
HIGH TEMPERATURE AND PERFORMANCE IN A FLIGHT TASK SIMULATOR
P. F. Iampietro, C. E. Melton, Jr., E. A. Higgins, J. A. Vaughan, S. M. Hoffmann, G. E. Funkhouser, and J. T. Saldivar May 1972 15 p refs
(FAA-AM-72-17) Avail: NTIS HC $3.00

The effects of high cockpit temperature on physiological responses and performance were determined on pilots in a general aviation simulator. The pilots (all instrument rated) flew an instrument flight while exposed to each of three cockpit temperatures: (1) 25.0 C (77 F), (2) 43.3 C (110 F), (3) 60.0 C (140 F). Each flight lasted about 50 minutes. Performance was scored as the deviations in heading from the predetermined flight path. Deviations were scored for seven segments of the flight. Physiological parameters recorded were: heart rate, deep body temperature, skin temperature and urine output and sweat loss. There were significant decrements in performance in three segments of the flight. Performance at 43 C was degraded over performance at 25 C during the 1st segment of flight. Performance at 43 and 60 C was degraded over performance at 25 C during Turn 1. Performance at 60 C was worse than performance at 25 and 43 C during the ILS segment. Results are discussed in terms of the complexity of the flight segment being flown. Author

N72-29075*# Department of Health, Education, and Welfare, Phoenix, Ariz. Environmental Microbiology Section.
SERVICES PROVIDED IN SUPPORT OF THE PLANETARY QUARANTINE REQUIREMENTS
Martin S. Favero Jun. 1972 23 p
(NASA Order W-13062)
(NASA-CR-127768; Rept-38) Avail: NTIS HC $3.25 CSCL 06M

Tests were conducted to determine the dry heat resistance at 125 C of a naturally occurring bacterial spore population in a mixture of sieved vacuum cleaner dusts from Cape Kennedy. The dust was aerosolized in a special chamber and was allowed to settle on 32 Teflon ribbons to provide approximately 500,000 spores per ribbon. Author

N72-29076# Central Inst. for the Deaf, St. Louis, Mo.
ELECTROPHYSIOLOGICAL CORRELATES OF BEHAVIORAL TEMPORARY THRESHOLD SHIFTS IN CHINCHILLA
Luis D. Benitez, Donald H. Eldredge, and Jerry W. Templer 1 Feb. 1972 27 p refs
(Contract Nonr-4327(00); NR Proj. 140-170)
(AD-740227) Avail: NTIS CSCL 06/19

A previous test exposed chinchillas for seven days to an octave band of noise centered at 500 Hz and at 95 db SPL to produce temporary shifts of behavioral auditory thresholds which required 4-7 days to recover to normal. In the present study physiological potentials were measured about 5, 24, and 48 hours after exposures to the same noise for 2 or 3 days. Cochlear microphonoic responses and dc endocochlear potentials were measured in each of the three cochlear turns. Input-output functions for whole-nerve action potential responses to clicks and visual detection levels for early averaged evoked responses arising in the brain stem were also measured. GRA

N72-29077# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
TWO BIODYNAMIC MODELS USED TO DETERMINE OPTIMUM ENERGY ABSORBER CHARACTERISTICS
Richard W. Carr Dec. 1971 22 p refs Presented at Symp. on Biodynamics Models and their Appl., Dayton, Ohio 26-28 Oct. 1970
(AF Proj. 7231)
(AD-740447; AMRL-TR-71-29-Paper-10) Avail: NTIS CSCL 01/2

Energy absorbers are generally designed to generate a constant force over their stroke length since constant force or square wave devices are the most efficient. The document is

concerned with the question of whether this type of energy absorber is suitable for protecting a seated man from high level accelerations such as those present in potentially survivable airplane crashes. The question was approached by using two biodynamic models of the seated human. One was used to determine human dynamic response to impact accelerations, for which the equations of motion of the system were determined. A computer program was used to solve for the seat acceleration which was then used as an input to a second biodynamic model. GRA

N72-29078# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
HUMAN OPERATOR PERFORMANCE IN HYPOXIC STRESS
Clyde R. Replogle, Frank M. Holden, Robert E. Gold, Linton L. Kulak, F. Jonas, and George Potor, Jr. Dec. 1971 17 p refs Presented at Symp on Biodynamics Models and their Appl., Dayton, Ohio, 26-28 Oct. 1971
(AF Proj. 7231)
(AD-740468; AMRL-TR-71-29-Paper-31) Avail: NTIS CSCL 06/19

The experiment was designed to assess the value of several different tracking tasks in quantitatively measuring the effects of hypoxia on human operator performance. Each subject was required to perform three tracking tasks. One was an adaptive first order unstable task. The second represented stable third order longitudinal airframe dynamics. The last was a two axis combination of the first two, with the stable task represented by the vertical display axis and the unstable task on the horizontal axis. A two by two analysis of variance was employed to provide estimates of the reliability of the measurements. The results indicate that the adaptive unstable task is significantly sensitive to hypoxic stress, whereas to identify similar changes in the stable task requires frequency domain analysis. There is some indication that the unstable task may be sensitive to 12,000 ft simulated hypoxia after only 2 minutes of exposure.
Author (GRA)

N72-29079# Arizona Univ., Tucson. Dept. of Chemistry.
MOLECULAR AND ELECTRONIC MECHANISMS OF BIOLOGICAL ENERGY CONVERSION PROCESSES Final Report, 20 Sep. 1967 - 1 Feb. 1971
Gordon Tollin 1 May 1971 87 p refs
(Contract F19628-68-C-0027)
(AD-735272; AFCRL-71-0343) Avail: NTIS CSCL 06/1

The chemistry and enzymology of flavin was studied by examining molecular complex formation with phenols and indoles and the binding of flavin analogs to apoprotein. Spectroscopic, kinetic, and thermodynamic approaches were used. Considerable insight was obtained into the role of environmental factors in modifying the chemical and physical properties of the flavin molecule. Chlorophyll one-electron photochemistry in solution was investigated using optical, ESR and flash photolysis techniques. Evidence was obtained for a chlorophyll-photosensitized one-electron transfer from solvent (alcohols, pyridine) to quinone leading to the formation of a chlorophyll-semiquinone complex stabilized via coordination with the central magnesium ion. Dissociation of this complex is followed by disproportionation of the semiquinone radicals. Author

N72-29322* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
PUBLIC HEALTH APPLICATIONS OF REMOTE SENSING
Charles E. Fuller *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 20 p Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 06C

N72-29408* California Univ., Berkeley. Forestry Remote Sensing Lab.
DEVELOPMENT OF ANALYSIS TECHNIQUES FOR REMOTE SENSING OF VEGETATION RESOURCES
William C. Draeger *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 13 p Original contains color illustrations (For availability see N72-29407 20-13)
CSCL 02C

05 BIOTECHNOLOGY

Includes life support systems, human engineering, protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N72-29080 Illinois Univ., Urbana. Aviation Research Lab.
STUDIES IN PILOT TRAINING: THE ANATOMY OF TRANSFER Aviation Research Monographs, volume 2, no. 1, Jun. 1972
Ralph E. Flexman, Stanley N. Roscoe, Alexander C. Williams, Jr., and Beverly H. Williges Jun. 1972 93 p refs
(LC-77-171977) Copyright. Avail: Issuing Activity

Data revelant to the specific mechanism of transfer of training from ground based simulators to piloting an aircraft are given. Two experiments, contact flight and instrument flight, were used to measure the percent of transfer and transfer effectiveness. E.H.W.

N72-29081*# Research Triangle Inst., Durham, N.C.
[BIOMEDICAL RESEARCH AND AEROSPACE TECHNOLOGY APPLICATIONS]
31 Dec. 1971 167 p refs
(Contracts NASw-1950; NASw-2273)
(NASA-CR-127792) Avail: NTIS HC $10.50 CSCL 06K

The accomplishments and activities of an Applications Team for biomedical subjects are presented. The team attempts to couple the technological problems and requirements in medicine with the relevant aerospace technology and, in particular, NASA-generated technology. The team actively engages in identifying these problems through direct contact with medical staffs or problem originators. The identification and specification of medical problems is followed by a search for technology which may be relevant to solutions to these problems. Author

N72-29082*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO 13 LiOH CANISTER BREAKTHROUGH TEST
J. C. LeBlanc 15 Jul. 1970 338 p
(Proj. Apollo)
(NASA-TM-X-68571; MSC-01343; CSD-A-1070) Avail: NTIS HC $19.00 CSCL 06K

The Apollo 13 lithium hydroxide canister test was conducted to evaluate emergency measures designed to enable the Apollo 13 crew to use command module lithium hydroxide canisters in the lunar module. The test verified the effectiveness of the emergency system and established that the canisters in the command module would provide ample carbon dioxide removal for the return of the Apollo 13 crew. The time interval between canister changes on the flight was also determined in the test. This reduced power demand on the lunar module by eliminating the need for telemetry in determining canister replacement times. Details of the canister modifications were relayed to the flight crew and a replica of the test system was assembled in the flight vehicle. Graphs of the parameters which were measured during the simulation are presented. Author

N72-29083*# Westinghouse Electric Corp., Pittsburgh, Pa.
CONCEPTUAL DESIGN STUDY OF A SIX-MAN SOLID ELECTROLYTE SYSTEM FOR OXYGEN RECLAMATION
J. P. Morris, C. K. Wu, L. Elikan, N. J. Bifano, and R. R. Holman [1972] 89 p refs

(Contract NAS1-8896)
(NASA-CR-112063) Avail: NTIS HC $6.50 CSCL 06K

A six-man solid electrolyte oxygen regeneration system (SEORS) that will produce 12.5 lbs/day of oxygen has been designed. The SEORS will simultaneously electrolyze both carbon dioxide and water vapor and be suitable for coupling with a carbon dioxide concentration system of either molecular sieve, solid amine or hydrogen depolarized electrochemical type. The total system will occupy approximately 19 cu ft (34.5 in. x .26 in. x 36 in. high) and will weigh approximately 500 pounds. It is estimated that the total electrical power required will be 1783 watts. The system consists of three major components; electrolyzer, hydrogen diffuser, and carbon deposition reactor. There are 108 electrolysis stacks of 12 cells each in the electrolyzer. Only 2/3 of the 108 stacks will be operated at a time; the remainder will be held in reserve. The design calls for 96 palladium membranes for hydrogen removal to give 60 percent redundancy. Four carbon deposition reactors are employed. The iron catalyst tube in each reactor weighs 7.1 lb and 100 percent redundancy is allowed. Author

N72-29084*# Michigan Univ., Ann Arbor. Engineering Human Performance Lab.
HUMAN STRENGTH SIMULATIONS FOR ONE AND TWO-HANDED TASKS IN ZERO GRAVITY
Apr. 1972 155 p refs
(Contract NAS9-10973)
(NASA-CR-115744) Avail: NTIS HC $9.75 CSCL 06S

A description is given of a three dimensional hand force capability model for the seated operator and a biomechanical model for analysis of symmetric sagittal plane activities. The models are used to simulate and study human strengths for one and two handed tasks in zero gravity. Specific conditions considered include: (1) one hand active, (2) both hands active but with different force directions on each, (3) body bracing situations provided by portable foot restraint when standing and lap belt when seated, (4) static or slow movement tasks with maximum length of 4 seconds and a minimum rest of 5 minutes between exertions, and (5) wide range of hand positions relative to either the feet or bisection of a line connecting the hip centers. Simulations were also made for shirt sleeved individuals and for the male population strengths with anthropometry matching that of astronauts. Author

N72-29085*# Baylor Univ., Houston, Tex.
RESEARCH PROGRAM FOR EXPERIMENT M133 Final Report
James D. Frost, Jr. 31 May 1972 56 p refs
(Contract NAS9-11855)
(NASA-CR-115745) Avail: NTIS HC $5.00 CSCL 06B

The development of the automatic data-acquisition and sleep-analysis system is reported. The purpose was consultation and evaluation in the transition of the Skylab M133 Sleep-Monitoring Experiment equipment from prototype of flight status; review of problems associated with acquisition and on-line display of data in near-real time via spacecraft telemetry; and development of laboratory facilities and design of equipment to assure reliable playback and analysis of analog data. The existing prototype system modified, and the changes improve the performance of the analysis circuitry and increase its reliability. These modifications are useful for pre- and postflight analysis, but are not now proposed for the inflight system. There were improvements in the EEG recording cap, some of which will be incorporated into the flight hardware. Author

N72-29086*# Stanford Research Inst., Menlo Park, Calif.
PERCEIVED NOISINESS UNDER ANECHOIC, SEMI-REVERBERANT AND EARPHONE LISTENING CONDITIONS
Frank R. Clarke and Karl D. Kryter Washington NASA Aug. 1972 30 p refs
(Contract NAS1-10017)
(NASA-CR-2108) Avail: NTIS HC $3.00 CSCL 06S

Magnitude estimates by each of 31 listeners were obtained for a variety of noise sources under three methods of stimuli presentation: loudspeaker presentation in an anechoic chamber, loudspeaker presentation in a normal semi-reverberant room, and earphone presentation. Comparability of ratings obtained in these environments were evaluated with respect to predictability of ratings from physical measures, reliability of ratings, and to the scale values assigned to various noise stimuli. Acoustic environment was found to have little effect upon physical predictive measures and ratings of perceived noisiness were little affected by the acoustic environment in which they were obtained. The need for further study of possible differing interactions between judged noisiness of steady state sound and the methods of magnitude estimation and paired comparisons is indicated by the finding that in these tests the subjects, though instructed otherwise, apparently judged the maximum rather than the effective magnitude of steady-state noises. Author

N72-29087*# Stanford Research Inst., Menlo Park, Calif.
THE METHODS OF PAIRED COMPARISONS AND MAGNITUDE ESTIMATION IN JUDGING THE NOISINESS OF AIRCRAFT
Frank R. Clarke and Karl D. Kryter Washington NASA Aug. 1972 40 p refs
(Contract NAS1-10017)
(NASA-CR-2107) Avail: NTIS HC $3.00 CSCL 20A

The point of subjective equality in regard to perceived noisiness for each of 14 pairs of aircraft noises was obtained using both magnitude estimation technique and the method of paired comparisons. Both methods gave approximately the same estimates of the points of subjective equality for the noise pairs, and both showed similar correspondence to predictive physical measures. Nevertheless, the two methods appear to have greater face validity to the listeners. However, the magnitude estimation technique appears to be more efficient; for a given level of reliability it requires approximately 50% of the testing time required by the paired comparison method. The functions relating physical intensity to the estimated magnitude of subjective noisiness had slopes ranging from about .61 to .29 for the aircraft noises employed in this study, indicating a required change of about 5 to 10 db for a doubling in subjective magnitude. Some physical units of noise measurement were found to be very predictive (standard errors of estimate as low as 1.9 db) of the subjective judgements of noisiness. Author

N72-29088# Civil Aeromedical Inst., Oklahoma City, Okla.
A PROPOSED NEW TEST FOR APTITUDE SCREENING OF AIR TRAFFIC CONTROLLER APPLICANTS
Bart B. Cobb and John J. Mathews May 1972 30 p refs
(FAA-AM-72-18) Avail: NTIS $3.50

The development and experimental validation of a novel aptitude test, referred to as Directional Headings (or DHT), for the selection of air traffic control specialist (ATCS) trainees are discussed. The test requires the subject to rapidly interpret letters, symbols, and degrees in order to determine: directional headings, the exact opposites of headings, and opposites of headings under conditions of aural distraction. The DHT was administered on an experimental basis to several hundred men as they entered basic ATCS training at the FAA Academy. Test subjects were pre-screened. Despite pre-screening, the DHT scores correlated .41 with an overall measure of training performance. Moreover, over 44 per cent of the 115 examinees who failed the training course scored no higher than 29 on the DHT whereas over 85 per cent of the graduates scored 30 or higher. Author

N72-29089# Lockheed Missiles and Space Co., Palo Alto, Calif.
THE SOYUZ LIFE SUPPORT SYSTEM
[1972] 3 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 6, 1972 p 46-47
Avail: NTIS HC $3.00; National Translation Center, John Crerar Library, Chicago, Ill. 60616

The Soyuz life support systems are described as well as principles for operating each system. E.H.W.

N72-29090# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Electron Physics.
ON THE OPTIMAL CHOICE OF SCATTERING FOILS FOR ELECTRON THERAPY
Anders Brahme Jun. 1972 31 p refs Submitted for publication
(TRITA-EPP-72-17) Avail: NTIS HC $3.75

The choice of scattering material for use in high energy electron therapy has been studied quantitatively from a theoretical point of view. The influence of the scattering material on the average energy loss, the most probable energy loss, the straggling and the bremsstrahlung contamination of a primary electron beam has been calculated for a given mean square angle of scattering. The influence of the different forms of degradations on the depth dose distributions is discussed and the wide range of possibilities for obtaining flattened electron beams is briefly reviewed. Author (ESRO)

N72-29091# Royal Aircraft Establishment, Farnborough (England). Engineering Physics Dept.
THE DYNAMIC BEHAVIOUR OF CRASH HELMETS
J. M. Rayne London Aeron. Res. Council 1972 73 p refs Supersedes RAE-TR-69160; ARC-31726
(ARC-CP-1202; RAE-TR-69160; ARC-31726) Avail: NTIS HC $5.75; HMSO £1.20; PHI $4.90

Work on the protection of the head in crashes is summarized. In general, two problems are seen to exist; the prevention of skull fracture and the prevention of concussion. The skull can be protected within quite wide limits by spreading the load, but little can be done directly by helmets of practicable size to prevent concussion. The likelihood of brain injury can be reduced slightly by designing helmets with low elasticity and a tendency to deflect blows. Kinetic energy and the peak force transmitted to the head are often regarded as the sole criteria needed to define a blow, but it is shown that the coefficient of restitution and stopping distance are also important parameters. Account should be taken of the effect of the ratio of the colliding masses and the effect of varying momentum when comparing test results from various rigs. A simple calibration device using a shaped plasticine test-piece is put forward to compare the behaviour of different test machines under given conditions. The effect of varying different parameters is illustrated by experiments on two test rigs and tests on existing service helmets are reported. Author (ESRO)

N72-29092# Royal Aircraft Establishment, Farnborough (England).
A LABORATORY COMPARISON OF THREE METHODS OF PERSONAL CONDITIONING
J. R. Allan, M. F. Allnutt, M. A. Beeny, R. de G. Hanson, J. Morrison, R. W. J. Needham, D. G. Robertson, and B. C. Short London Aeron. Res. Council 1972 39 p refs Supersedes RAE-TR-70212; seen71-30127 ARC-32961 Prepared jointly with Roy. Air Force Inst. of Aviation Med.
(ARC-CP-1210; RAE-TR-70212; ARC-32961) Avail: NTIS HC $4.00; HMSO: 65p; PHI: 2.65

Twelve subjects were used to obtain comparative data between a water cooled, a convective air cooled, and a reverse flow air cooled personal conditioning system during laboratory simulations of a typical operational sortie in a hot climate. The results generally favored the water cooled system on physiological, behavioral and subjective grounds. Author (ESRO)

N72-29093# Army Edgewood Arsenal, Md.
EVALUATION OF A POWER-ASSISTED BREATHING DEVICE. PART 1: AIRFLOW CHARACTERISTICS. PART 2: SUBJECTIVE PREFERENCE FOR AIRFLOWS OVER THE FACE Technical Report, Mar. - Apr. 1971
E. G. Cummings, W. V. Blevins, and C. R. Bulette Apr. 1972 20 p refs
(DA Proj. 1W6-62710-A-D25)
(AD-740643; EA-TR-4639) Avail: NTIS CSCL 06/17

The power-assisted breathing device was conceived to reduce gas mask resistance. This device consisted of a battery-operated blower attached to the inspiratory ports of the M17A1 mask, which was designed for continuous operation during wear. It supplied a flow of air through filters at 56 liters/min; this flow varies during wear with the phase of breathing. Subjective preferences for airflows over the face were tested from 75 to 250 liters/min for design information. Subjective opinions are discussed. Author (GRA)

N72-29094# Naval Training Device Center, Orlando, Fla.
EYE MOVEMENT RESEARCH PROGRAM: VISUAL TRAINING Annual Report
Stephen Jordan and Urbano Manfredi Mar. 1972 51 p refs
(AD-741246; NAVTRADEVCEN-IH-202; AR-2) Avail: NTIS CSCL 05/5

In a series of experiments, significant improvements were found in ocular pursuit tracking with practice. These improvements, which held for various directions of tracking, endured beyond the training period. Also, the effect of ocular pursuit training on subsequent performance in a variety of visualmotor tasks was studied. In two transfer of training experiments, a high degree of positive transfer was found in the first but not in the second study. Author (GRA)

N72-29095# Sperry Rand Corp., Great Neck, N.Y. Gyroscope Div.
VISUAL REQUIREMENTS STUDY FOR HEAD-UP DISPLAYS Final Report
T. Gold and R. F. Perry Mar. 1972 65 p refs
(Contract N00014-68-C-0465; NR Proj. 213-068)
(AD-741218; JANAIR-700407) Avail: NTIS CSCL 05/5

An experimental study was conducted to determine the binocular disparity tolerances for pilots viewing dynamic head-up display images against a moving real world background. An existing head-up display simulator, which could generate images with controlled disparities for each eye, was modified to incorporate a background of projected motion pictures taken in flight at low altitudes. Six pilots served as test subjects, three from the Army Aviation School and three from the Naval Air Test Center. The results indicate maximum disparity levels for sustained comfortable viewing of 1.0 milliradian for vertical and convergent horizontal disparities, and 2.5 milliradians for divergent horizontal disparities. These results are the same as those obtained with the display viewed against a static real world background in a preceding study involving a different group of subjects. Author (GRA)

N72-29096# Atlantic Research Corp., Alexandria, Va. Kinetics and Combustion Group.
HABITABLE ATMOSPHERES WHICH DO NOT SUPPORT COMBUSTION Final Technical Report
Edward T. McHale 15 Mar. 1972 155 p refs
(Contract DAHC19-71-C-0026; DA Proj. 2O0-61102-B-13-B; DA Proj. 2N0-611-02-B-71-D)
(AD-741808) Avail: NTIS CSCL 13/12

It is believed that atmospheres can be developed which will not support combustion of ordinary materials such as paper, plastics, solvents, etc., and in which humans will be able to live and function normally for extended periods of time. Such atmospheres would contain relatively small amounts (10-20%) of certain fully-fluorinated agents (CF4, C2F6, or C3F8) added to air. The presence of the agents would completely suppress the burning of materials, but because they are physiologically inert and present in small concentration, they would not appreciably affect the life support process. The objective of the present study was to evaluate the avalidity of this concept. The toxicity tests included acute and ten-day inhalation studies on rats and guinea pigs and cardiac sensitization tests on dogs (with CF4). Author (GRA)

N72-29097# School of Aerospace Medicine, Brooks AFB, Tex.
DEVELOPMENT OF A SOLID-STATE IMPEDANCE PLETHYSMOGRAPH FOR RESEARCH IN A SPACE

ENVIRONMENT Technical Report, Apr. - Jul. 1970
John W. Yates Dec. 1971 35 p refs
(AF Proj. 6320)
(AD-740866; SAM-TR-71-49) Avail: NTIS CSCL 06/2

A new solid-state impedance plethysmograph utilizing a constant current source was designed, built, and tested. The report presents the design philosophy, the circuitry, the final configuration of the device, and the technics for its proper alignment. The circuit detects a 1% impedance change centered on basal body impedance levels between 100 ohms and 15 kilohms. Although normally operated at 100 kHz, the circuit will operate at various frequencies, and it will accommodate either the bipolar or tetrapolar electrode configuration. Circuit performance was confirmed by taking thoracic impedance measurements on a human subject. Author (GRA)

N72-29098# Cornell Univ., Ithaca, N.Y.
PERFORMANCE OF AN AUDIO PERCEPTRON Ph.D. Thesis
Mark Gordon Scattergood Jun. 1971 116 p refs
(Contract Nonr(G)00003-71; NR Proj. 371-961)
(AD-740125) Avail: NTIS CSCL 06/4

Perceptrons are a class of simple adaptive pattern-recognition devices built of crude model neurons. In the work a perceptron is used to recognize patterns generated by an audio preprocessor. The preprocessor is modeled on the cochlea and cochlear ganglion of the cat with the assumption that these systems are similar to those in humans. Nonsense syllables are used as input to the preprocessor and the perceptron is taught to dichotomize the syllables through a negative-reinforcement training procedure. The preceptron is tested for its ability to learn various dichotomies as a function of the complexity of the dichotomy and as a function of the number of different voices used. It is further tested for its ability to generalize from one set of speakers to another. Author (GRA)

N72-29099# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
INTERFACING MAN-MACHINE CONTROL PERFORMANCE IN A BIODYNAMIC ENVIRONMENT
Henry R. Jex Dec. 1971 23 p refs Presented at the Symp. on Biodyn. Models and their Appl., Dayton, Ohio, 26-28 Oct. 1971
(AF Proj. 7231)
(AD-740467; AMRL-TR-71-29-Paper-30) Avail: NTIS CSCL 05/8

The purpose of this presentation is to review the state of the art in interfacing man-machine control performance in a biodynamic environment. It is given in three parts: (1) a review of the models which are appropriate for manual control performance and the added elements necessary to deal with biodynamic interfaces, (2) some simplified relationships relating the parameters of the models to the resulting man-machine performance, and (3) a review of some biodynamic interface pilot/vehicle problems which have occurred, been solved, or need to be solved. Author (GRA)

N72-29100# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
DYNAMIC SIMULATION TECHNIQUES FOR THE DESIGN OF ESCAPE SYSTEMS: CURRENT APPLICATIONS AND FUTURE AIR FORCE REQUIREMENTS
James W. Brinkley and John T. Shaffer Dec. 1971 34 p refs Presented at Symp. on Biodynamics Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970
(AF Proj. 7231)
(AD-740439; AMRL-TR-71-29-Paper-2) Avail: NTIS CSCL 13/12

Research in biodynamics has made very significant contributions to the fulfillment of Air Force operational requirements in the area of emergency escape system design in certain select aspects. The development of dynamic models to describe the response of the human to given environments has provided the aircraft designer with a powerful design and evaluation tool expressed in his own engineering language. Multiple degree-of-freedom models currently used to study the performance of escape systems and the effects of the design of their subsystems can be modified to incorporate the biodynamic model to assess the influence of escape system model outputs on the human. The parameters of escape system components may thereby be varied analytically to study their effect on human response and, conversely, the analysis can also show the influence of human body dynamics upon the performance of the escape system. GRA

N72-29101# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
SOME ASPECTS OF BIODYNAMIC MODELLING FOR AIRCRAFT ESCAPE SYSTEMS
Peter R. Payne Dec. 1971 104 p refs Presented at Symp. on Biodynamics Models and their Appl., Dayton, Ohio, 26-28 Oct. 1970
(AF Proj. 7231)
(AD-740446; AMRL-TR-71-29-Paper-9) Avail: NTIS CSCL 06/7

In today's high-speed aircraft there is little possibility of escape unless an ejection seat or capsule is employed, and future flight envelopes are extending to the point where even an escape seat may be inadequate, partly because of the injuries caused by wind blast, and partly because the amount of vertical acceleration required to clear the aircraft structure (usually the fin) may be so great that the seat occupant will be seriously injured by the escape system itself. A biodynamic model of the human body is presented in order to study the tolerances to aircraft ejection. GRA

N72-29056 Joint Publications Research Service, Arlington, Va.
SANITARY-HYGIENIC EVALUATION OF THE EXTRACTION METHOD FOR REGENERATING WATER FROM A CONDENSATE OF ATMOSPHERIC MOISTURE
Yu. Ye. Sinyak, L. A. Kuznetsova, M. I. Shikina, A. G. Filchakov, and V. V. Krasnoshchekov *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 30-34 refs (For availability see N72-29051 20-04)

N72-29057 Joint Publications Research Service, Arlington, Va.
SOME METHODS FOR TRANSPORTING LIQUID WASTES OF THE VITAL FUNCTIONS OF A CREW AND SANITARY-WASTE WATER DURING SPACE FLIGHTS
V. P. Yefimov and V. A. Frolov *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 35-39 refs (For availability see N72-29051 20-04)

N72-29071 Joint Publications Research Service, Arlington, Va.
METHOD FOR COMPUTING SOME PARAMETERS FOR THE ENVIRONMENTAL CONTROL SYSTEM OF A SPACESUIT
I. P. Abramov *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 129-136 refs (For availability see N72-29051 20-04)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N72-29102*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
THE REACTION OF OH WITH NO2
R. Simonaitis and Julian Heicklen 22 Feb. 1972 26 p refs

(Grants NGL-39-009-003; NSF GA-12385)
(NASA-CR-127790; PSU-IRL-SCI-380) Avail: NTIS HC $3.50 CSCL 07D

NO2 was photolyzed with 2288A radiation at 300 and 423 K in the presence of H2O, CO, and in some cases excess He. The photolysis produces O(1D) atoms which react with H2O to give HO radicals or are deactivated by CO to O(3P) atoms. The ratio k sub 5/k sub 3 is temperature dependent, being 0.33 at 300 K and 0.60 at 423 K. From these two points the Arrhenius expression is estimated to be k sub 5/k sub 3 = 2.6 exp(-1200/RT) where R is in calories/mole - K. The OH radical is either removed by NO2 or reacts with CO. Author

N72-29103*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
ON THE PRODUCTION OF N2O FROM THE REACTION OF O(1 D) WITH N2
R. Simonaitis, Eduardo Lissi, and Julian Heicklen 22 Feb. 1972 16 p refs
(Grants NGL-39-009-003; NSF GA-12385)
(NASA-CR-127791; PSU-IRL-SCI-389) Avail: NTIS HC $3.00 CSCL 07D

Ozone was photolyzed at 2537 A and 25 C in the presence of 42-115 torr of O2 and about 880 torr of N2 to test the relative importance of the two reactions: (1) O(1D) + N2 + M yields N2O + M, and (2) O(1D) + N2 yields O(3P) + N2. N2O was not found as a product. Thus from our detectability limit for N2O (0.3 micron), an upper limit to the efficiency of the first reaction relative to the second of 0.0000025 at 1000 torr total pressure was computed. This corresponds to k1/k2 smaller than 0.8 x 10 to the minus 25 power cu cm/particle. Author

N72-29104*# Texas Univ., Dallas.
STUDY OF EXCITATION TRANSFER IN A FLOWING HELIUM AFTERGLOW PUMPED WITH A TUNEABLE DYE LASER. 1: MEASUREMENT OF THE RATE COEFFICIENT FOR SELECTED QUENCHING REACTIONS INVOLVING He(5 3P)
C. B. Collins, B. W. Johnson, and M. J. Shaw [1972] 23 p refs
(Grant NGL-44-004-001)
(NASA-CR-127778; SP-72-006-1) Avail: NTIS HC $3.25 CSCL 07D

A system is described for the measurement of excited state reaction times in the nanosecond range. A flowing afterglow produces large populations of chemically unstable species, and a pulsed, tuneable dye laser is used to selectively pump these into the reacting excited state. The transient fluorescence from the populations of reactants and end products is used to determine reaction lifetimes and yields. This radiatron is collected with a photon counting system which logs arrival times of spectrally dispersed photons with 10 nanosecond resolution. Author

N72-29105# Wayne State Univ., Detroit, Mich. Dept. of Chemistry.
RESEARCH ON THE SIZE AND SHAPE OF LARGE MOLECULES AND COLLOIDAL PARTICLES Final Report, 1 Jun. 1970 - 30 Nov. 1971
Wilfried Heller 10 Apr. 1972 37 p refs
(Contracts N00014-70-C-0410; Nonr-3511(00); NR Proj. 051-380)
(AD-740318) Avail: NTIS CSCL 07/4

The report discusses the author's research and presents his publications and summaries of the research. The summaries include: Determination of particle sizes and size distributions from light scattering; Determination of the shape of rigid particles and macromolecules from light scattering in flowing systems; Determination of the deformability of macromolecules from light scattering in flowing systems; Determination of the molecular shape or conformation for molecular weights -50,000 from depolarization of scattered light. Author (GRA)

N72-29106# General Electric Co., Santa Barbara, Calif. DNA Information and Analysis Center.
DASAIC REACTION RATE DATA. NO. 30: DNA REACTION RATE PROGRAM Annual Progress Summary, FY 1971
Aug. 1971 35 p
(Contract DASA01-70-C-0035)
(AD-741239) Avail: NTIS CSCL 07/4

The report presents summaries of the Defense Nuclear Agency Reaction Rate Research Programs for FY 1971. The topics included suvh areas as: Upper atmosphere winds; Metal oxide chemistry; Ion-molecule reactions; Ozone and Hydroxyl aeronomy; Interatomic interactions; IR spectra of uranium oxide compounds; Ion-ion neutralization cross sections; Atomic collisions and plasma physics; Aeronomy; Interactions of ions and neutral atoms and molecules. Author (GRA)

N72-29107# Johns Hopkins Univ., Baltimore, Md.
PRELIMINARY EXPERIMENTS ON THE GAS-PHASE IGNITION MECHANISM OF AMMONIUM PERCHLORATE Final Report, 1 Mar. - 30 Oct. 1971
Karl Jakus 1972 13 p refs
(Grant DA-ARO(D)31-124-71-G97)
(AD-740178; AROD-9559-1-C) Avail: NTIS CSCL 07/4

The results of the sublimation experiments that were performed and which were intended to be preparatory to the study of the gas-phase ignition mechanisms of Ammonium Perchlorate(A-P) are summarized. These experiments were comprised of the study of the deposition rates from sublimating A-P as function of sublimation temperature, and the comparison of the mass spectra of the sublimating reagent grade A-P with that of already sublimed A-P. The results reinforce the previously reported observations that decomposition competes with sublimation in the temperature range of 100 C to 200 C. Furthermore, the results also indicate that the sublimed A-P is less stable than the reagent grade A-P. Author (GRA)

N72-29108# GCA Corp., Bedford, Mass. Technology Div.
THEORETICAL STUDY OF ATOMIC AND MOLECULAR PROCESSES Final Report, 25 Mar. 1970 - 25 Jun. 1971
Alexander Dalgarno and George A. Victor Apr. 1972 73 p refs
(Contract DASA01-70-C-0091)
(AD-740784; GCA-TR-71-10-G; DNA-2773F) Avail: NTIS CSCL 07/4

The report presents the findings of a number of individual investigations relevant to the physics of atomic and molecular processes in the upper atmosphere as pertinent to the problem of the rate of reduction of ionization in a disturbed atmosphere. Calculations have been performed of the rates for three-body ion-electron recombination X(-) - e - M yields X - M. The process of associative detachment X(-) - Y yields XY - e is an important mechanism for the removal of negative atomic and molecular ions. Improved calculations of potential energy curves O2(-), relative to theoretical O2 curves, have been performed. The cross section for rotational excitation in electron polar molecule collisions, e M(J) yields e - M (J - Delta J), where M(J) is a polar molecule in rotational state J, is large. Detailed calculations have been performed for the cross section for rotational excitation of carbon monoxide by electron impact using close-coupling methods. Author (GRA)

N72-29109# Ohio State Univ. Research Foundation, Columbus.
GAS DIAGNOSTICS UTILIZING LASER INDUCED RAMAN SCATTERING Final Scientific Report
Anthony A. Boiarski Jan. 1972 22 p refs
(Contract F33615-67-C-1758)
(AD-740568; ARL-72-0008) Avail: NTIS CSCL 07/4

The feasibility of using various techniques to determine the chemical and thermodynamic state of individual species in a flowing gas mixture is discussed. It is theoretically shown that, using the Raman scattering technique, species concentration can be determined for individual molecular constituents. Also, the

static temperature of the gas and the vibrational temperature of molecular species can be obtained. The apparatus used for the present Raman scattering measurements is described and experimental data on the species concentrations of oxygen and nitrogen in air are presented. Limitations of the technique are also discussed. Author (GRA)

N72-29110# Purdue Univ., Lafayette, Ind. Project SQUID Headquarters.
THE INTERACTION OF SOUND WITH GAS PHASE REACTIONS
Robert G. Gilbert, Hong-Sup Hahn, Peter J. Ortoleva, and John Ross Apr. 1972 36 p refs Prepared in cooperation with MIT, Cambridge Sponsored in part by NSF
(Contract N00014-67-A-0226-0005; NR Proj. 098-038; Proj. SQUID)
(AD-742351; SQUID-TR-MIT-65-PU) Avail: NTIS CSCL 07/4

Reaction and sound propagation are coupled in ideal gas phase reactions which have a difference in the sums of stoichiometric voefficients of reactants and products, or which have a pressure-dependent rate coefficient. Numerical and approximate analytical (WKB-type) solutions are obtained for the hydrodynamic equations which take into account this coupling and which describe the spatial and temporal variations in density, velocity and concentration for an isothermal system far from equilibrium. Specific results are given for a unimolecular reaction of the type A yields B and C, where sound is shown to be amplified in both high and low pressure regions, with an accompanying change in frequency; the system is unstable to small perturbations. Possible applications include a new method for the determination of rate coefficients by acoustic means.
Author (GRA)

N72-29111# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
VIBRATIONAL RELAXATION OF CARBON DIOXIDE IN EXPANDING FLOWS Final Technical Report, 1 May 1967 - 31 Dec. 1971
Anthony L. Russo Jan. 1972 56 p refs
(Contract N00014-67-C-0339; NR Proj. 061-169)
(AD-742101; CAL-RM-2430-A-1) Avail: NTIS CSCL 07/4

Vibrational relaxation of CO2 with Ar, N2, and CO and the vibrational relaxation of pure CO have been studied in shock-tube driven, quasi-steady supersonic expansion flows in a two-dimensional wedge nozzle. The experiments were conducted over a range of reservoir temperatures of about 2500 K to about 4000 K and at a reservoir pressure of about 20 atm. The diagnostic technique was based on quantitative measurements of infrared radiation from CO2 and the CO fundamental vibration-rotation band. The results indicate that the vibrational relaxation of CO(v3) in the expansion flows proceeds at a rate nearly that obtained from shock wave studies. The efficiency of argon in deexciting CO2 vibration is estimated. CO is found to relax vibrationally about two orders of magnitude faster than anticipated on the basis of shock-wave results. The results of CO/CO2 mixtures indicate strong coupling of the vibrational deexcitation of these species. Author (GRA)

N72-29112# Columbia Univ., New York.
THE PHYSICS OF OPTICALLY PUMPED VAPORS AND ADVANCED OPTICALLY PUMPED ELECTRONICS DEVICES Final Report, 1 Nov. 1967 - 31 Oct. 1971
W. Happer Apr. 1972 13 p refs
(Grant AF-AFOSR-1454-68; AF Proj. 9767)
(AD-742306; AFOSR-72-1131TR) Avail: NTIS CSCL 07/4

Briefly discussed are research results arising from extensive measurements of lifetimes, hyperfine structures, gyromagnetic ratios and electric polarizabilities for selected excited states of atoms and molecules. Many of these parameters are important for the design of lasers, masers, magnetometers and other devices. A firm theoretical and experimental understanding of parametric interactions between light and microwaves in optically pumped vapors has been attained. A list of publications is given.
Author (GRA)

N72-29113# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
CHEMICAL TESTS: PROPELLANTS, GASES AND METALS Final Report
15 Jan. 1971 98 p refs Revised
(AMCR Proj. 310-6)
(AD-742324; TOP-5-2-585-Rev) Avail: NTIS CSCL 07/4

The report prescribes a method for evaluation of missile system materials. It identifies chemical analysis tests, facilities, and equipment for use, as appropriate. The report provides procedures for propellant, gas, and metal tests. It is applicable to missile system material properties determined by chemical tests. Author (GRA)

N72-29114# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
HOMOGENEOUS NUCLEATION IN STEAM NOZZLE CONDENSATION
Dieter Barschdorff, William J. Dunning, Benjamin J. C. Wu, and Peter P. Wegener May 1972 9 p refs
(Contract N00014-67-A-0097-0012)
(AD-742460; REPT-23) Avail: NTIS CSCL 07/4

Comparison of results on the onset of condensation by homogeneous nucleation of water vapor in an inert gas or pure steam has revealed differences on the nucleation rate. Pure steam condenses less rapidly than the water vapor in moist air. Calculations are presented that rationalize one possible contribution to this discrepancy. The calculations demonstrate that pure steam condensation just as that of water vapor appears to be in reasonable agreement with the so-called classical theory of nucleation. Author (GRA)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N72-29115*# Martin Marietta Corp., Denver, Colo.
PROTOTYPE DATA TERMINAL-MULTIPLEXER/DEMULTIPLEXER Final Report
D. E. Leck and J. E. Goodwin May 1972 131 p
(Contract NAS8-27538)
(NASA-CR-123746; MCR-72-123) Avail: NTIS HC $8.75 CSCL 17B

The design and operation of a quad redundant data terminal and a multiplexer/demultiplexer (MDU) is described. The most unique feature is the design of the quad redundant data terminal. This is one of the few designs where the unit is fail/op, fail/op, fail/safe. Laboratory tests confirm that the unit will operate satisfactorily with the failure of three out of four channels. Although the design utilizes state-of-the-art technology, the waveform error checks, the voting techniques, and the parity bit checks are believed to be used in unique configurations. Correct word selection routines are also novel. The MDU design, while not redundant, utilizes, the latest state-of-the-art advantages of light coupler and interested amplifiers. Much of the technology employed was an evolution of prior NASA contracts related to the Addressable Time Division Data System. A good example of the earlier technology development was the development of a low level analog multiplexer, a high level analog multiplexer, and a digital multiplexer. A list of all drawings is included for reference and all schematic, block and timing diagrams are incorporated. Author

N72-29116*# Aerojet-General Corp., El Monte, Calif. Microwave Div.
A STUDY OF RADIOMETRIC EMISSION FROM A ROUGH

SEA SURFACE Final Technical Report
A. Stogryn Washington NASA Jul. 1972 80 p refs
(Contract NAS1-10633)
(NASA-CR-2088; Rept-3000R-1) Avail: NTIS HC $3.00 CSCL 20N

The equations which describe the emissivity of a rough ocean surface are developed. The theory includes effects of large scale and small scale wave structure and the influence of shadowing by the large ocean waves. Also included are investigations of the emission properties of foam and the influence of the thermal boundary layer on the brightness temperature characteristics of the ocean surface. Author

N72-29117*# California Univ., Los Angeles. Plasma Physics Group.
REMOTE DOUBLE RESONANCE COUPLING OF RADAR ENERGY TO IONOSPHERIC IRREGULARITIES
Charles F. Kennel Jan. 1971 16 p refs
(Grant NGL-05-007-190; Contracts N00014-69-A-0200-4023; AT(04-3)-34; Grant NSF GP-22817; Proj. 157)
(NASA-CR-127748; R-85) Avail: NTIS HC $3.00 CSCL 17I

Experimental results indicate that low frequency modulation of a high power radar beam, tuned to one of the critical frequencies of the ionosphere, may produce field-aligned density irregularities when the modulation frequency matches an ionospheric eigenfrequency. By choosing the radar carrier frequency and polarization, a number of interaction layers were selected. The variety of possible excitations shows that the double resonance technique may be adaptable to a number of different objectives. Author

N72-29118# Federal Aviation Administration, Washington, D.C. Communications Branch.
TERMINAL-MODIFIED RADAR VIDEO DATA PROCESSOR (TMRVDP) PERFORMANCE FOR CONDITIONS OF SCAN-CORRELATED PERCENT NOISE CONTROL, ENABLED AND INHIBITED
Martin H. Holtz Jan. 1972 11 p
(FAA Proj. 142-171-04X)
Avail: NTIS HC $3.00

Test results obtained describing operational characteristics, within weather clutter environments, of the terminal-modified radar video data processor (TMRVDP) for conditions of scan-correlated percent noise control (gain word function), enabled and inhibited, are presented. Author

N72-29119# Federal Aviation Administration, Washington, D.C. Communications Branch.
APPLICATION OF SSB TECHNIQUES TO A/G COMMUNICATIONS
Charles Santora Jan. 1972 42 p
Avail: NTIS HC $4.25

Single sideband (SSB) transmission is studied for possible advantageous use in very high frequency (VHF) and ultrahigh frequency (UHF) ground stations. Author

N72-29120# Institute for Telecommunication Sciences, Boulder, Colo.
MEASURED AND PREDICTED LONG TERM DISTRIBUTIONS OF TROPOSPHERIC TRANSMISSION LOSS
A. G. Longley, R. K. Reasoner, and V. L. Fuller Jul. 1971 369 p refs
(OT/TRER-16) Avail: SOD $2.75

Measurements of tropospheric transmission loss and its long-term variability for nearly 800 paths in various parts of the world are summarized. The measurements were made at frequencies from 40 MHz to 10 GHz over distances which range from 10 to 1000 km. Terrain profiles and cumulative distributions of both observed and predicted losses are plotted for more than 500 of these paths. A preliminary analysis of differences between observed and predicted values is included. Author

N72-29121# Institute for Telecommunication Sciences, Boulder, Colo.
HIGH FREQUENCY PROPAGATION PREDICTIONS AND ANALYSIS FOR CIRCUITS FROM THE USCG SAN FRANCISCO RADIO STATION TO SHIPS AND AIRCRAFT OPERATING IN THE NORTH PACIFIC AREA
R. D. Hunsucker Jun. 1971 157 p refs
(OT/TRER-15) Avail: SOD $1.25

An investigation of the capability of the U.S. Coast Guard San Francisco HF radio station to communicate with ships and aircraft in the northern Pacific Ocean area is described. The general high-latitude HF propagation problem is discussed, and the ITS propagation prediction computer program has been modified to include some high-latitude ionospheric effects. Results are presented in the form of computer printouts showing: (1) geographic plots of communication reliability contours for the areas of interest, (2) frequency usage histograms for each of the four specified areas, and (3) antenna takeoff angle histograms for all areas. Author

N72-29122# Institute for Telecommunication Sciences, Boulder, Colo.
URBAN RESIDENTIAL MAN MADE RADIO NOISE ANALYSIS AND PREDICTIONS
A. D. Spaulding, W. H. Ahlbeck, and L. R. Espeland Jun. 1971 72 p refs
(OT/TRER-14) SOD $0.65

During May and June of 1968 a man-made radio noise survey of San Antonio, Texas, was conducted. The results of part of this survey of residential urban man-made radio noise are given, along with the correlations of the measured values of noise power density with population density and vehicular count (traffic density). Also given are various detailed amplitude and time statistics of man-made noise recorded in the vicinity of Grand Coulee Dam, Washington, and in an urban area of Boulder, Colorado. Author

N72-29123# Institute for Telecommunication Sciences, Boulder, Colo.
LOCAL AND DIURAL VARIATIONS IN GROUND-BASED RADIO REFRACTIVITY GRADIENTS AT TROPICAL LOCATIONS
B. A. Hart, G. D. Thayer, and H. T. Dougherty Nov. 1971 70 p refs
(OT/TRER-23) SOD $0.65

The distribution and variability of ground-based radio refractivity gradients in tropical areas of the world and those found in temperature climates where the annual range of daily mean temperature is much larger than the daily temperature range are compared. Examples of the refractivity vertical structure in locations from 30 N to 30 S, are presented to show that very large diurnal and interdiurnal fluctuations in surface gradients are the rule rather than the exception. These fluctuations, only slightly affected by seasonal cycles, are largely dependent on diurnal insolation and local features, such as terrain, prevailing winds and moisture sources. Author

N72-29124# Joint Publications Research Service, Arlington, Va.
TRANSMISSION OF SECAM COLOR TELEVISION SIGNALS WITH SOUND PORTION VIA MOLNIYA-1 COMMUNICATION SATELLITE
L. A. Sevalnev and V. F. Lyubenko 28 Aug. 1970 6 p refs
Transl. into ENGLISH from Elektrosvyaz (Moscow), no. 5, 1970 p 46-49
(JPRS-51265) Avail: NTIS HC $3.00

Combined transmission of television and audio signals are described. This combination is used to ensure quality in color and black and white broadcasts. The Molniya 1 communication satellite was used for these signal transmission tests. J.A.M.

N72-29125# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
APERTURE BLOCKAGE IN DUAL REFLECTOR ANTENNA

SYSTEMS: A REVIEW
J. Dijk, J. M. Berends, and E. J. Maanders Sep. 1971 48 p refs
(TH-71-E-23) Avail: NTIS HC $4.50

Various aspects of blockage effects on the performance of circularly symmetrical dual reflector antenna systems, where the aperture of the main reflector is partly blocked by a subreflector with four struts, are dealt with. Approximated and exact methods are discussed for calculating the blockage effects on the basis of geometrical optics, and a justification of the diffraction effects is given. Expressions found for calculating the influence of the blocked parts on the general direction gain pattern, lead to interesting conclusions regarding the near sidelobe levels in certain directions. Detailed calculations are given of the blockage efficiency with respect to several parameters, such as F/D ratio, aperture illumination, strut and subreflector dimensions, and the implantation of the struts on the main reflector. ESRO

N72-29126# Marconi Space and Defence Systems Ltd., Camberley (England).
STUDY OF THE ADAPTATION OF THE EUROPEAN COMMUNICATIONS SATELLITE TO A TELEVISION BROADCAST SATELLITE. VOLUME 1: SUMMARY AND CONCLUSIONS Final Report
Mar. 1972 33 p refs 3 Vol.
(Contract ESTEC-1470/71)
(T(F)-520-Vol-1; ESRO-CR(P)-105-Vol-1) Avail: NTIS HC $6.75

Summary and conclusions are presented of a study on the adaptation of the European communications satellite to community and direct television broadcasting. Two distinct satellites have been defined for these purposes, which are distinguished by widely different transponder powers required for the two missions. The community color TV requirements are based on picture quality and make an allowance for quality degradation in the community distribution links. The baseband luminance signal to noise ratio needed at the receiving earth station is set at 45 db (weighted), and the satellite equivalent isotropic radiated power (EIRP) at 56 dbW. The direct TV requirements are based on picture quality in the coverage area. A weighted baseband luminance signal to noise ratio of 42 db has been chosen, and a satellite EIRP of 66.6 dbW has been defined. ESRO

N72-29127# Marconi Space and Defence Systems Ltd., Camberley (England).
STUDY OF THE ADAPTATION OF THE EUROPEAN COMMUNICATIONS SATELLITE TO A TELEVISION BROADCAST SATELLITE. VOLUME 2: COMMUNITY BROADCAST Final Report
Mar. 1972 226 p 3 Vol.
(Contract ESTEC-1470/71)
(T-(F)-520-Vol-2; ESRO-CR(P)-106-Vol-2) Avail: NTIS HC $13.50

The communication subsystem and the satellite configuration necessary for the European communications satellite's adaptation to community TV broadcasting are defined. The proposal discusses the satellite antennas, the frequency plan, filtering losses, radio frequency power output, power output tubes, transponder design, and the terrestrial interface equipment for the communications system. A synthesis is presented of the spacecraft system which includes power and error budgets, payload, satellite configuration, mass properties and the subsystem. ESRO

N72-29128# Marconi Space and Defence Systems Ltd., Camberley (England).
STUDY OF THE ADAPTATION OF THE EUROPEAN COMMUNICATIONS SATELLITE TO A TELEVISION BROADCAST SATELLITE. VOLUME 3: DIRECT BROADCAST Final Report
Mar. 1972 179 p
(Contract ESTEC-1470/71)
(T(F)-520-Vol-3; ESRO-CR(P)-107) Avail: NTIS HC $11.00

Communication subsystems and a satellite configuration suitable for the European communication satellite adaptation to direct television broadcasting are defined. The communications system including the satellite antennas and radio frequency beam pointing systems are described; the frequency plan, filtering and multiplexing losses, radio frequency output power, are estimated. Power amplifier tubes, direct TV, transponder design, and terrestrial interface are described. The spacecraft systems synthesis is presented, including power and error budgets, payload, configuration of all properties and subsystems. Finally the spacecraft reliability is evaluated. ESRO

N72-29129# Hawker Siddeley Dynamics, Ltd., Stevenage (England). Space Div.
STUDY OF THE ADAPTATION OF THE EUROPEAN COMMUNICATIONS SATELLITE TO A TELEVISION BROADCAST MISSION. VOLUME 1: SUMMARY AND CONCLUSIONS Final Report
P. Brunt, comp. Mar. 1972 59 p 4 Vol.
(Contract ESTEC-1469/71-SL)
(HSD-TP-7303-Vol-1; ESRO-CR(P)-108-Vol-1) Avail: NTIS HC $5.00

A summary is presented of a study on the adaptation of the European communications satellite to community and individual television broadcasting. The two missions involve transmission of TV programs from the satellite to community receiving antennas with further local distribution, and direct transmission to individual receiving antennas. The satellite requirements are outlined, and the main difference in the missions is seen to be the equivalent isotropic radiated power (EIRP) which is 59 dbW for the community system and 68 dbW for the individual system. The satellite system design, and subsystem design, are summarized. Critical areas and additional developments necessary are discussed. ESRO

N72-29130# Hawker Siddeley Dynamics, Ltd., Stevenage (England). Space Div.
STUDY OF THE ADAPTATION OF THE EUROPEAN COMMUNICATIONS SATELLITE TO A TELEVISION BROADCAST MISSION. VOLUME 2: STUDY REPORT ON COMMUNITY TV Final Report
Mar. 1972 264 p refs 4 Vol.
(Contract ESTEC-1469/71-SL)
(HSD-TP-7303-Vol-2; ESRO-CR(P)-109-Vol-2) Avail: NTIS HC $15.25

The communication subsystems and the satellite configuration necessary for the European communications satellite's adaptation to community TV broadcasting are defined. The proposal discusses the satellite system design, antenna configurations, system definition including mission analysis, satellite description and parameters, subsystem design including communications, structure and mechanisms, thermal control, power supplies, and attitude and orbital control. ESRO

N72-29131# Hawker Siddeley Dynamics, Ltd., Stevenage (England). Space Div.
STUDY OF THE ADAPTATION OF THE EUROPEAN COMMUNICATIONS SATELLITE TO A TELEVISION BROADCAST MISSION. VOLUME 3: STUDY REPORT ON INDIVIDUAL TV Final Report
Mar. 1972 130 p 4 Vol.
(Contract ESTEC-1469/71-SL)
(HSD-TP-7303-Vol-3; ESRO-CR(P)-110-Vol-3) Avail: NTIS HC $8.50

The communication subsystems and the satellite configuration necessary for the European communications satellite's adaptation to individual TV broadcasting are defined. The proposal discusses the satellite system design, antenna configurations, system definition including mission analysis, satellite description and parameters, subsystem design including communications structure and mechanisms, thermal control, power-supplies, and attitude and orbital control subsystems. ESRO

N72-29132# Hawker Siddeley Dynamics, Ltd., Stevenage (England). Space Div.
STUDY OF THE ADAPTATION OF THE EUROPEAN COMMUNICATIONS SATELLITE TO A TELEVISION BROADCAST MISSION. VOLUME 4: APPENDICES TO STUDY REPORT Final Report
Mar. 1972 183 p refs 4 Vol.
(Contract ESTEC-1469/71-SL)
(HSD-TP-7303-Vol-4; ESRO-CR(P)-111-Vol-4) Avail: NTIS HC $11.25

Several topics of interest to the European communications satellite's adaptation to TV broadcasting are discussed. They include TV noise performance and downlink budget, radio frequency sensing and antenna steering, determination of the radio frequency axis of an antenna to a given datum, filtering possibilities for output multiplexers, antenna disk distortion, ray tracing of a Cassegrain antenna system, design of digital shunt regulator, detailed analysis of subsystem power condition, an alternative solution dispensing with N-S station keeping for the community TV satellite, detail analysis of the DGF control system, error analysis of IR sensor, double gimbal flywheel control system research on the dynamic response of the TV broadcasting satellite with flexible paddles, description of the main thermal mathematical model, passive radiator analog computer simulation, and a spare satellite philosophy. ESRO

N72-29133# Tennessee Univ., Tullahoma. Space Inst.
FSK SPECTRA GENERATION Final Report, 1 Jan. 29 Feb. 1972
Thomas H. Gee Apr. 1972 67 p refs
(Contract N00014-72-C-0171)
(AD-740768) Avail: NTIS CSCL 17/2

The results of a study of a phase locked modulation technique applicable to phase coherent FSK are presented. This technique employs a continuous phase, frequency shifted, phase locked loop to produce controlled, non-instantaneous, frequency transitions between the mark and space frequencies. Operational and spectral analyses have been conducted, and spectral data have been calculated for the modulated carrier signal and its corresponding effective modulating signal. It is shown that effective modulation wave-shaping can be achieved and that the corresponding signal bandwidths can be controlled within certain limits by variation of the loop parameters, undamped natural frequency and open loop gain. Representative data are presented, corresponding to a selected class of loop parameters, as a function of modulation index and the ratio of frequency transition time to bit length. Author (GRA)

N72-29134# Rome Air Development Center, Griffiss AFB, N.Y.
CALIBRATION OF C-131 AND KC-135 AIRCRAFT AS HF TEST VEHICLES Final Report, Dec. 1970 - Dec. 1971
Edward J. Christopher and Joseph L. Parry Feb. 1972 91 p refs
(AD-740553; RADC-TR-72-14) Avail: NTIS CSCL 09/5

The report describes a method of accurately calibrating two aircraft test vehicles by using an HF standard gain ground reference antenna whose design includes ground conductivity parameters. Analytical and experimental test programs were performed with a C-131 aircraft and its wing-tip mounted loop antenna and a KC-135 aircraft with its boom mounted loop antenna and fuselage mounted long wire antenna. Both type aircraft were calibrated as a complete receiving unit thereby taking into account variations in antenna pattern performance which result when the frequency of operation approaches the resonant frequency of the air frame. Author (GRA)

N72-29135# Naval Research Lab., Washington, D.C.
CALCULATION OF THE RADAR CROSS SECTION OF A PERFECTLY CONDUCTING SPHERE Final Report
Lamont V. Blake Apr. 1972 27 p refs
(AD-740746; NRL-MR-2419) Avail: NTIS CSCL 17/9

A FORTRAN computer program has been written to compute the radar cross section of a conducting sphere. The program is useful when a metal sphere is used as a standard target for calibrating a radar for target-cross-section measurement. It has been used to machine-plot with high precision a curve of cross section (normalized to the optical cross section) as a function of the radius/wavelength ratio. The computed data used to plot the curve are also presented in tabular form. The mathematics of the problem are briefly reviewed, and a listing of the computed program is given. Author (GRA)

N72-29136# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
RESEARCH ON THE ESTIMATION OF TRAJECTORIES FROM RADAR DATA Quarterly Progress Report, 1 Aug. - 31 Oct. 1971
Raymond S. Berkowitz, M. Plotkin, D. B. Luber, and S. Gottesman Feb. 1972 78 p refs
(Contract DAAB07-71-C-0212; DA Proj. 1S6-63719-DK-72)
(AD-740876; ECOM-0212-2; QPR-2) Avail: NTIS CSCL 17/9

The general purpose of the work reported here is to obtain the best possible feasible signal processing algorithms for estimating from radar data characteristics and trajectory parameters of bodies moving in the air. Author (GRA)

N72-29137# Tamir (T.), Teaneck, N.J.
EFFECT OF A FOREST ENVIRONMENT ON THE PERFORMANCE OF DOPPLER RADAR SYSTEMS
T. Tamir Dec. 1971 54 p refs
(Contract DA-31-124-ARO(D)-120)
(AD-741349; LWL-CR-05P70) Avail: NTIS CSCL 17/9

The aim of the report is to examine the effect of a forest environment on the performance of a remote sensing system that detects the Doppler-shifted signal scattered by moving objects. For this purpose, the influence of the terrain on the radar equation is determined by estimating the additional path loss due to the presence of dissipative media between the transmitter antenna and the moving scatterer. For most situations of practical importance, it is shown that the additional path loss can be expressed in terms of a terrain factor, which accounts for the presence of both the foliage and the ground. This terrain loss is evaluated for the case of a moving target located in the vegetation, and for a transmitter antenna that may be placed either inside the vegetation or above the tree tops. The calculated results are given for a wide range of distances between the antenna and the target, for various antenna heights and for different types of wooded areas. Author (GRA)

N72-29138# North Carolina State Univ., Raleigh. Dept. of Electrical Engineering.
OPTIMIZING INFORMATION TRANSMISSION IN A DIGITAL TELEVISION ENCODING SYSTEM
James A. Gardner and Stanley M. Soliday 4 Apr. 1972 13 p refs
(Contract F44620-69-C-0033)
(AD-740622; AFOSR-72-0866TR) Avail: NTIS CSCL 17/2

Relationships between human response and digital television encoder parameters were investigated by measuring subjects' minimum perceptible acuities. Variations in sampling frequency and quantizing noise were simulated for a differential pulse code modulation encoding system by changing bandwidths and signal-to-noise ratios of pictures displayed on the monitor of a closed circuit television system. Noise had little or no effect on the minimum perceptible acuity over the ranges tested. Information transmission was profoundly affected by bandwidth and very little affected by noise in the system. This was true for all degrees of system complexity and cost tested. Author (GRA)

N72-29139# University of Southern Calif., Los Angeles.
RESEARCH ON OPTICAL IMAGE PROCESSING Final Report, 1 Jul. 1970 - 31 Aug. 1971
William K. Pratt, H. C. Andrews, L. A Liporace, and L. R. Welch Feb. 1972 29 p refs
(Contract F44620-70-C-0113)

(AD-740620; AFOSR-72-0757TR) Avail: NTIS CSCL 09/2

Research on computer processing of optical information included coding, enhancement and detection using monochrome and color images. A bandwidth reduction and tolerance to channel errors for monochrome images have resulted from digital image transforms. Sample reductions on the order of the ratio 5 to 1, compared to conventional PCM coding, have been reported for transform coding of monochrome images. The generalized Wiener filtering technique has been applied to the enhancement of images. A new measure of similarity between images has been developed which is proposed as a useful detection criterion. The measure has information theoretic properties and, with proper image normalization, is the entropy function. Five manuscripts have been submitted for publication and eight papers were presented at various conferences/symposia.

Author (GRA)

N72-29140# Harry Diamond Labs., Washington, D.C.

DEVELOPMENT OF AN ULTRA-WIDEBAND MAGNETIC-TAPE RECORDER, PHASE 1

Karl H. Krey, J. Carlisle Hoadley, and Allison S. Hill Dec. 1971 59 p refs

(HDL Proj. 23229)

(AD-741369; HDL-TR-1573) Avail: NTIS CSCL 14/3

The main efforts were concentrated on extending the upper frequency limits from the conventional 2 MHz to about 50 MHz and beyond. This report presents the results of phase I of this program, which includes HDL efforts along with those of a commercial contractor. Successful recordings were made at tape speeds about 8 times those of the fastest conventional longitudinal recorders. Tape velocities of 1,500 in/sec with a respective recording interval of 7 seconds were possible without any damage to tape or head. Author (GRA)

N72-29141# Texas Instruments, Inc., Austin. Digital Systems Div.

NUMERICAL SAMPLING TECHNIQUES INVESTIATION Final Technical Report, Jul. 1970 - Aug. 1971

Alan L. McBride and Dan K. Raley Griffiss AFB, N. Y. RADC Feb. 1972 116 p refs

(Contract F30602-70-C-0180)

(AD-740597; TI-U1-978101F; RADC-TR-72-6) Avail: NTIS CSCL 09/5

The report is devoted to the investigation of techniques for implementing an all-digital oscillator and the applications of this oscillator in communication equipment. Two techniques of implementing the digital oscillator are discussed: the recursive technique which uses recursive difference equations as the oscillator algorithm and the nonrecursive technique which uses permanently stored values of sine waves and corresponding control logic to generate output sine waves. The nonrecursive implementation approach was selected for breadboard design. Breadboard design, construction and performance evaluation are considered. The oscillator operates in two modes: as a frequency synthesizer and a digitalized voltage controlled oscillator (VCO). Applications of these two modes in communication function implementations are presented as well as a new technique for implementing digitalized FM demodulation. Author (GRA)

N72-29142# Avco Corp., Cincinnati, Ohio. Electronics Div.

RADIO SET AN/PRC-70 Quarterly Report, 1 Oct. 1971 - 1 Jan. 1972

C. A. Bucher Fort Monmouth, N. J. ECOM Feb. 1972 65 p refs

(Contract DAAB07-71-C-0319)

(AD-740232; ECOM-0319-2; Rept-80045-PRC34/272; QR-2) Avail: NTIS CSCL 17/2

The report covers the development work to date on the AN/PRC-70 HF/VHF Radio Set for manpack usage. The primary effort of the interval was in the area of breadboard work to evaluate the performance of the various circuits and technical approaches. Much breadboard progress was achieved in the tuner, IF, audio, squelch, and transmitter PA circuits where the approaches being used appear to be capable of meeting the requirements. Author (GRA)

N72-29143# Bell Aerospace Co., Buffalo, N.Y.

A STUDY OF WEIGHTED AND OPERATOR MODIFIED LMSE ALGORITHMS FOR PROBABILISTICALLY DEFINED INPUTS

Lester A. Gerhardt and William J. Walbesser (State Univ. of N. Y.) 4 Apr. 1972 5 p

(Contract AF 49(638)-1627)

(AD-740480; AFOSR-72-0864TR) Avail: NTIS CSCL 09/4

An algorithmic process is developed which minimizes the least mean squared error resulting from a set of input vectors applied to a system such as communications, control, or guidance. These systems are characterized by the need for continual updating in order to remain adaptive to their environment. The results reported in the paper have helped to establish a unifying thread among algorithmic techniques for using probabilistic inputs in such adaptive systems as pattern recognition, control systems optimization techniques, and sequential estimation theory. Author (GRA)

N72-29144# IIT Research Inst., Chicago, Ill.

STUDY OF CONCEPTS FOR NAVY TACTICAL VOICE COMMUNICATIONS

Robert V. Janc, Barry I. Marks, and Nickolas T. Thomopoulos Apr. 1972 71 p refs

(Contract N00014-70-C-0375; NR Proj. 274-118)

(AD-740137; IITRI-E6174-24; TR-11) Avail: NTIS CSCL 17/2

The objective of this program was to formulate and develop an analytical model based on queueing theory for the purpose of evaluating various tactical voice net configurations and signaling alternatives. Results presented from the analytic queueing model are presented here in the context of specific Naval tactical net situations. The results illustrate only the use of the methodology developed; consequently, mathematical derivations have been omitted with the exception of a brief technical summary. Specifically, those areas examined are mutual signaling interference, multiple access-discrete address (MADA) systems, preemptive/non-preemptive priority, busy signal, hold call and non-Poisson statistics. Each of these various performance measures (e.g., Grade of Service) are illustrated graphically as functions of net utilization. Author (GRA)

N72-29145# Rome Air Development Center, Griffiss AFB, N.Y.

A STUDY OF MULTIPLE ACCESS WAVE FORMS WITH ACOUSTIC SURFACE WAVE MATCHED FILTERS

Henry J. Bush Feb. 1972 50 p refs

(AD-740582; RADC-TR-72-15) Avail: NTIS CSCL 09/4

The report describes a study into synchronization problems of various spread spectrum waveforms for direct mode, multiple access systems. Particular attention is paid to user mutual interference and how this interference influences the choice of the waveform. Computer generated cross-correlation properties of the 18 basic 127 chip m-sequences are given in simulating a pure code division system. The basic pseudo-noise sequence is implemented by acoustic surface wave matched filters. The performance of these matched filters under various interference conditions (including multipath) is given. Author (GRA)

N72-29146# Institute for Telecommunication Sciences, Boulder, Colo.

AN ENGINEERING STUDY OF COMMUNICATIONS IN A SUBTERRANEAN WAVEGUIDE

L. L. Haidle 17 Apr. 1972 33 p refs

(NAonr-12-72)

(AD-741237) Avail: NTIS CSCL 17/2

The report considers the signal strength at a point in a subterranean waveguide and compares it with the noise one might expect; noise is that owing to atmospheric and subsurface thermal sources. The signal is due to a transmitting antenna located in the waveguide. A prediction is thus made on

signal-to-noise ratio at the receiving point. The prediction permits an engineering estimate of the likely distance one could communicate via this subterranean waveguide, based on assumed waveguide parameters. Author (GRA)

N72-29147# Naval Underwater Systems Center, Newport, R.I.
OPERATING CHARACTERISTICS FOR MAXIMUM LIKEHOOD DETECTION OF SIGNALS IN GAUSSIAN SIGNALS OF UNKNOWN LEVEL
Albert H. Nuttall and Peter G. Cable 27 Mar. 1972 67 p refs
(AD-742358; NUSC-TR-4243) Avail: NTIS CSCL 09/4

The detection and false-alarm probabilities for maximum likelihood detection of coherent signals in noise, where the signal and noise levels are unknown, are derived and evaluated. The maximum likelihood detector is shown to be optimum in the following sense: out of the class of processors that yields a specified false-alarm probability without knowledge of the noise level, it is uniformly most powerful for unknown (positive) signal level. Author (GRA)

N72-29148# Electronic Systems Div., L. G. Hanscom Field, Mass.
A PROBABILISTIC METHOD OF OPTIMIZING FREQUENCY SELECTION IN HIGH FREQUENCY (HF) COMMUNICATIONS SYSTEMS
Charles G. Cobb and Arthur L. Masson May 1972 41 p refs
(AD-742300; ESD-TR-72-148) Avail: NTIS CSCL 20/14

The report considers the problem of predicting the overall reliability and optimum frequencies of a communications system such as an air/ground system which must be able to communicate over a broad geographical area at various times of day. The report describes a probabilistic method of synthesizing all the frequency and reliability data from the area of communications and calculating the overall reliability as a function of frequency. The method described can be implemented in a digital computer program and can provide a valuable management tool for planning the operation of air/ground systems. Author (GRA)

N72-29149# General Dynamics Corp., San Diego, Calif. Electro Dynamic Div.
RF LINKS FOR OCEAN DATA STATIONS
R. F. Devereux, K. A. Morgan, K. Samples, and L. A. Scott Sep. 1971 120 p
(Contract N00014-70-C-0180; NR Proj. 083-147)
(AD-742129; R-71-045) Avail: NTIS CSCL 17/2

An experiment was conducted to provide data to compare with predicted path characteristics for frequencies in the 3 to 30 MHz oceanic telemetry band. Data obtained was for use in designing telemetry equipment for buoys at sea and for command receiving stations on shore. The receiving site was located in Hawaii, while the simulated buy-at-sea site was San Diego, California. Author (GRA)

N72-29150# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
MATHEMATICAL RESEARCH IN SIGNAL AND IMAGE PROCESSING Yearly Progress Report, 1 Mar. 1971 29 Feb. 1972
William A. Parkyn, Jr., Steve R. Webb, and Gordon E. Cash Apr. 1972 63 p refs
(Contract F44620-71-C-0052)
(AD-742304; MDC-G3007; AFOSR-72-1114TR) Avail: NTIS CSCL 09/4

The report describes research results in three areas of current interest in the general field of mathematics for signal and image processing. The first of these is the area of fast correlation and convolution using Walsh functions. Improvements are presented to an existing algorithm for fast correlation of signals and it is shown how the results apply to convolution as well. Details are presented for the adaptation of both operations to two-dimensional data. The new techniques offer promise for image enhancement and template matching. The second area is that of the logical Walsh transform, which previously showed promise for application to binary images. A detailed analysis reveals that the transform loses its simplicity when applied to signals of longer length and, for length 16 signals, the transform reversibility breaks down. The final area is pattern preconditioning for acoustic signals. Author (GRA)

N72-29151# National Academy of Sciences-National Research Council, Washington, D.C.
SUMMARY STATEMENT OF THE AD HOC PANEL ON SANGUINE
Henry G. Booker May 1972 85 p refs Supported by Navy
(AD-742361) Avail: NTIS CSCL 17/2

The Academy Ad Hoc Panel on Sanguine has examined two questioning papers to determine whether there are specific technical issues concerning Sanguine that have not been correctly assessed by the Navy. The Panel finds the following with regard to the technical basis for a Sanguine System: (1) The results of test transmissions strongly suggest that the Sanguine System will work as expected by the Navy; (2) There is no significant reason to disagree with the technical methods used by the Navy for predicting system performance; (3) The Navy is right in predicting that a properly insulated antenna buried below the earth will operate the same as an antenna 10 meters above the ground. Author (GRA)

N72-29152# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
GENERATION OF REFLECTION SURFACES FOR SIMULATING IONOSPHERIC PROPAGATION CONDITIONS
K. Toman, J. V. OBrien, and L. A. Whelan, Jr. 17 Feb. 1972 18 p refs
(AF Proj. 5631)
(AD-741755; AFCRL-ERP-388; AFCRL-72-0139) Avail: NTIS CSCL 20/14

In a computer experiment, a corrugated mirrorlike reflection surface was made to move horizontally above a plane containing a pair of points representing a bistatic ionospheric radar. The reflection surface was synthesized by the superposition of sinusoidal cylindrical waves that were allowed to move in different directions. A search routine was developed to find the rays that pass through the pair of points and satisfy specular reflection conditions at the surface. Path lengths and their derivatives were computed. The resulting patterns are descriptive and predictive of the effects of wavelike ionospheric perturbations on radio signal characteristics. Author (GRA)

N72-29153# Air Weather Service, Scott AFB, Ill.
NORMALIZATION PROCEDURES FOR SUDDEN PHASE ANOMALY EVENTS
William A. Wisdon, Jr. Apr. 1972 26 p refs
(AD-742265; AWS-TR-248) Avail: NTIS CSCL 20/14

The author discusses a procedure whereby Sudden Phase Anomalies (SPA) can be classified as Major Events, Significant Events, or Minor Events. Also, by determining the path responsiveness of a path at any given time, normalization factors can be applied to an observed event to determine its absolute importance, or its relative importance when compared to a standard event. The report contains the procedures necessary to determine the path responsiveness and normalization factors for any given VLF path. Standardized event categories are established for operational use, and equations are presented to define event categories on any SPA circuit. Author (GRA)

N72-29154# Mitre Corp., Bedford, Mass.
DISCRETE CLUTTER MEASUREMENTS PROGRAM: OPERATIONS IN THE METROPOLITAN BOSTON AREA
William J. McEvoy Mar. 1972 61 p refs
(Contract F19628-71-C-0002; AF Proj. 4110)
(AD-742298; MTR-2085; ESD-TR-72-131) Avail: NTIS CSCL 17/9

A mobile experimental radar facility was constructed which

permits the study of the discrete clutter of various terrains. The report describes the results obtained in the metropolitan Boston area. Author (GRA)

N72-29155# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
FREQUENCY SHIFT DURING IONOSPHERIC PROPAGATION OF RADIO WAVES OF SHORT WAVE RANGE
S. A. Namazov 11 Jan. 1972 21 p refs Transl. into ENGLISH from Radiotekhn. Elektron. (Moscow), v. 16, no. 6, Jun. 1971 p 905-913
(AD-741752; AFCRL-Trans-96; AFCRL-72-0050) Avail: NTIS CSCL 20/14

The frequency shift during reflection of radio waves from an ionospheric layer varying in time is considered. Plane stratified and spherically stratified isotropic layers are analyzed for oblique incidence of the radio wave as well as the anisotropic layer for vertical incidence. The method for the determination of the temporal variation of local electron concentrations from simultaneous measurements of frequency shift and group time delay in the ionosphere at two neighboring frequencies is described. Author (GRA)

N72-29156# Singer-Kearfott, Pleasantville, N.Y. Kearfott Div.
HELIUM SPEECH INVESTIGATIONS Final Technical Report, Jun. 1970 - Nov. 1971
Robert A. Flower 31 Dec. 1971 64 p refs
(Contract N00014-70-C-0387; NR Proj. 197-001)
(AD-741730) Avail: NTIS CSCL 17/2

The basic objective of the work was to continue evaluations of and achieve further improvements in the Singer-Kearfott unscrambler technique. The report summarizes briefly the work completed. Two major new topics are reported; an investigation of the formant shift in neon-air, and a miniaturization study of the existing unscrambler configuration. Functional descriptions and design data are presented on two miniaturization approaches for a helium unscrambler, one using an all-digital circuit and one using a novel analog memory. The analog approach is attractive, requiring fewer circuit elements and less power drain than the digital type. Author (GRA)

N72-29157# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
CLASSIFICATION OF OVERLAPPING WAVEFORMS WITH PATTERN RECOGNITION TECHNIQUES M.S. Thesis
Dennis E. Small Mar. 1972 86 p refs
(AD-741734; GE/EE/72-23) Avail: NTIS CSCL 09/4

An investigation of the utility of pattern recognition techniques in the classification of overlapping waveforms is made using sporadic-Poisson signals as a model. The signals consist of repetitions of three-bit binary components which occur and also overlap in a random manner. The sporadic occurrence rate and overlap features of the signal model approximate to some extent the nature of overlapping radar returns from closely spaced targets. Elements of pattern recognition models applied include the Fast Fourier Transform, filtering in the discrete frequency domain, and the Euclidean distance metric. Classification tests are made on four types of sporadic-Poisson signals using various filtering combinations (including variance filters) and with a nearest prototype classification rule. Author (GRA)

N72-29326* Lockheed Electronics Co., Houston, Tex.
DETECTION OF OIL SPILLS USING 13.3 GHz RADAR SCATTEROMETER
K. Krishen *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 27 p refs Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 17I

N72-29335* Michigan Univ., Ann Arbor. Willow Run Labs.
MULTISPECTRAL IMAGING RADAR
L. J. Porcello and R. A. Rendleman *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 18 p (For availability see N72-29327 20-13)
(Contract NAS9-1106)
CSCL 17I

N72-29336* Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.
SPACE CONFIGURATION AS AN EXPLANATION FOR LITHOLOGY-RELATED CROSS-POLARIZED RADAR IMAGE ANOMALIES
James R. McCauley *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 9 p refs (For availability see N72-29327 20-13)
(Contract NAS9-10261)
CSCL 17I

N72-29337* Kansas Univ./Center for Research, Inc., Lawrence.
THE STATUS OF PARAMETRIC STUDIES IN RADAR AGRICULTURE
Stanley A. Morain *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 17 p refs (For availability see N72-29327 20-13)
(Contract NAS9-10261)
CSCL 17I

N72-29339* Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.
RADAR SIGNATURE AND SYSTEMS STUDIES AT KANSAS UNIVERSITY
Richard K. Moore *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 37 p Original contains color illustrations (For availability see N72-29327 20-13)
CSCL 17I

N72-29356* Geological Survey, Menlo Park, Calif.
SATELLITE RELAY TELEMETRY IN THE SURVEILLANCE OF ACTIVE VOLCANOES AND MAJOR FAULT ZONES
Jerry P. Eaton and Peter L. Ward *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 17 p refs (For availability see N72-29355 20-13)
CSCL 09F

08 COMPUTERS

Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics.

N72-29158*# State Univ. of New York, Stony Brook. Coll. of Engineering.
SORTING AND ORDERING SPARSE LINEAR SYSTEMS
R. P. Tewarson Jan. 1970 20 p refs Presented at Conf. on Large Sparse Sets of Linear Equations, Oxford, England, 5-8 Apr. 1970
(Grant NGR-33-015-013)
(NASA-CR-127767; Rept-151) Avail: NTIS HC #3.00 CSCL 09B

Transformations of sparse linear systems by row-column permutations are considered and various algorithms are constructed to transform arbitrary symmetric positive definite sparse matrices, as well as matrices in band form, doubly bordered band form, and doubly bordered block diagonal form. G.G.

N72-29159*# Advanced Technology Labs., Inc., Jericho, N.Y.
INSTRUCTIONS FOR THE USE OF THE FORTRAN 4 PROGRAM COMPT
Edgar Alzner Dec. 1971 81 p refs
(NASA-CR-127766; ATL-TM-162) Avail: NTIS HC $6.25 CSCL 09B

The programming manual for the program COMPT which computes the non-steady two dimensional flow field resulting from the interaction of two successive blade rows is presented. The manual is designed to provide guidance in running the program and a brief description of some of the numerical details. A brief review of the main features of the program is given.
Author

N72-29160*# Mississippi State Univ., State College.
AN INNOVATIVE APPROACH TO COMPENSATOR DESIGN
Interim Report, 1 Jan. - 30 Apr. 1972
Jerrel R. Mitchell 30 Apr. 1972 115 p refs
(Contract NAS8-21377)
(NASA-CR-123747) Avail: NTIS HC $7.75 CSCL 09B

The primary goal is to present for a control system a computer-aided-compensator design technique from a frequency domain point of view. The thesis for developing this technique is to describe the open loop frequency response by n discrete frequency points which result in n functions of the compensator coefficients. Several of these functions are chosen so that the system specifications are properly portrayed; then mathematical programming is used to improve all of these functions which have values below minimum standards. In order to do this several definitions in regard to measuring the performance of a system in the frequency domain are given. Next, theorems which govern the number of compensator coefficients necessary to make improvements in a certain number of functions are proved. After this a mathematical programming tool for aiding in the solution of the problem is developed. Then for applying the constraint improvement algorithm generalized gradients for the constraints are derived. Finally, the necessary theory is incorporated in a computer program called CIP (compensator improvement program).
Author

N72-29161*# Harvard Univ., Cambridge, Mass.
ARBITRARY GRAMMARS GENERATING CONTEXT-FREE LANGUAGES
Brenda S. Baker 14 Jun. 1972 31 p refs
(Grant NGR-22-007-176)
(NASA-CR-127764; Rept-11-72) Avail: NTIS HC $3.75 CSCL 09B

If G is a grammar such that in each noncontext-free rule of G, the right side contains a string of terminals longer than any terminal string appearing between two nonterminals in the left side; then the language generated by G is context-free. Six previous results follow as simple corollaries of this theorem.
Author

N72-29162*# TRW Systems Group, Redondo Beach, Calif.
DEVELOPMENT OF SPECTRAL ANALYSIS MATH MODELS AND SOFTWARE PROGRAM AND SPECTRAL ANALYZER, DIGITAL CONVERTER INTERFACE EQUIPMENT DESIGN
Final Report
W. L. Hayden and L. H. Robinson 16 Jun. 1972 164 p refs
(Contract NAS9-11977)
(NASA-CR-115711; TRW-20817-H012-R0-00) Avail: NTIS HC $10.25 CSCL 09B

Spectral analyses of angle-modulated communication systems is studied by: (1) performing a literature survey of candidate power spectrum computational techniques, determining the computational requirements, and formulating a mathematical model satisfying these requirements; (2) implementing the model on UNIVAC 1230 digital computer as the Spectral Analysis Program (SAP); and (3) developing the hardware specifications for a data acquisition system which will acquire an input modulating signal for SAP. The SAP computational technique uses extended fast Fourier transform and represents a generalized approach for simple and complex modulating signals.
Author

N72-29163*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IBM SYSTEM/360 ASSEMBLY LANGUAGE INTERVAL ARITHMETIC SOFTWARE
E. J. Phillips (Computing and Software, Inc.) Apr. 1972 20 p refs
(NASA-TM-X-65971; X-552-72-147) Avail: NTIS HC $3.00 CSCL 09B

Computer software designed to perform interval arithmetic is described. An interval is defined as the set of all real numbers between two given numbers including or excluding one or both endpoints. Interval arithmetic consists of the various elementary arithmetic operations defined on the set of all intervals, such as interval addition, subtraction, union, etc. One of the main applications of interval arithmetic is in the area of error analysis of computer calculations. For example, it has been used sucessfully to compute bounds on sounding errors in the solution of linear algebraic systems, error bounds in numerical solutions of ordinary differential equations, as well as integral equations and boundary value problems. The described software enables users to implement algorithms of the type described in references efficiently on the IBM 360 system.
Author

N72-29164*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXTENDED PRECISION SOFTWARE PACKAGES
E. J. Phillips (Computing and Software, Inc.) Feb. 1972 36 p refs
(NASA-TM-X-65968; X-552-72-119) Avail: NTIS HC $4.00 CSCL 09B

A description of three extended precision packages is presented along with three small conversion subroutines which can be used in conjunction with the extended precision packages. These extended packages represent software packages written in FORTRAN 4. They contain normalized or unnormalized floating point arithmetic with symmetric rounding and arbitrary mantissa lengths, and normalized floating point interval arithmetic with appropriate rounding. The purpose of an extended precision package is to enable the user to use and manipulate numbers with large decimal places as well as those with small decimal places where precision beyond double precision is required.
Author

N72-29165# Bureau of Mines, College Park, Md. Metallurgy Research Center.
MATHEMATICAL SMOOTHING OF DIGITIZED X-RAY SPECTRA
Harold E. Marr, III 1972 19 p refs
(BM-IC-8553) Avail: NTIS HC $3.00

A simple algorithm is presented for processing digitized X-ray spectra obtained with a Si(Li) or Ge(Li) semiconductor detector coupled to a multichannel analyzer. The simplified least-squares procedure is used to smooth out the statistical fluctuations in the spectrum by repeatedly fitting a quadratic equation to a predetermined number of channels and performing a traveling smooth across the spectrum. A logarithmic transform is applied to the raw data to minimize the distortion of the Gaussian-shaped peak profiles. The efficacy of the technique is evaluated by observing the distortion of several Gaussian-shaped peaks that have been subjected to the smoothing operation. The locations of maximums and minimums in the spectrum are predicted in the process as well as the values of the peak heights. The convolution integers from a least-squares fit of a quadratic equation are calculated as part of a FORTRAN subroutine.
Author

N72-29166# National Physical Lab., Teddington (England). Div. of Numerical Analysis and Computing.
BASIC STATEMENT TIMES FOR ALGOL 60
B. A. Wichmann May 1972 47 p refs
(NPL-NAC-15) Avail: NTIS HC $4.50

A method of evaluating the processing speed of an ALGOL system is given using the times of execution for basic statements.

All the times obtained to date (29 March 1970) are also included. ESRO

N72-29167# Selenia S.p.A., Rome (Italy). Space Activities Div.
STUDY AND SIMULATION OF AN ON-BOARD COMPUTER FOR A SATELLITE. VOLUME 1: SUMMARY
S. Boesso, A. Bellini, S. Bottalico, M. Canevari, P. Franchiotti, G. Cicerchia, B. DiMarco, R. Gamberale, F. Marcoz, and R. Somma Paris ESRO Mar. 1972 126 p
(Contract ESTEC-1115/70)
(ESRO-CR(P)-70-Vol-1) Avail: NTIS HC $8.50

A general purpose computer for use onboard a satellite is studied. The proposed machine has to satisfy very exacting requirements: power consumption around 10 watts, weight around 5 kg, volume around 0.005 cubic meter, probability of success 90% in 12 to 18 months in orbit. The computer architecture is tailored to the results of the analysis of some typical satellite missions, considered to be representative of a wide range of spacecraft applications. The proposed computer is reprogrammable in flight via a TT & C system. It is microprogrammed and can be easily expanded in a multiprocessing configuration. The latter characteristics make the computer attractive for a range of applications appreciably wider than foreseen at the beginning of the study. Simulator and assembler programs, to be run on an IBM 360 computer, are supplied, which make it easy to write and debug operational programs on the ground before or during flight. Author (ESRO)

N72-29168# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et des ses Applications Spatiales.
FAULT DETECTION METHOD IN SEQUENTIAL SYSTEMS
P. Azema, M. Courvoisier, and J. P. Richard [1971] 10 p refs
(LAAS-Publ-912) Avail: NTIS HC $3.00

A method for the generation of fault detection tests in sequential and combinational systems is described. A solution was chosen which was restricted to certain fault types. The method originates from the topological description and executes an analysis to determine the Boolean expressions of internal variables. The excitation matrix or the flow diagram is then easily obtained. A combinational tree network is associated with each connection, chosen as internal variable. This form allows the detection of any fault, by acting only on the primary inputs. The method can be applied also to combinational or sequential networks and was easily programmed. ESRO

N72-29169# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
UTILIZATION OF REDUNDANCY REDUCTION SYSTEM WITH ZERO-ORDER PREDICTOR FOR STUDY OF EPISODIC PROCESSES
E. M. Vassiliev, B. S. Novicov, V. A. Olshevski, and Y. M. Shtarkov 1972 19 p
(PR-95) Avail: NTIS HC $3.00

A redundancy reduction device is described enabling onboard data compression for individual satellite-borne experiments, and especially for registration of solar radii bursts with duration of less than 0.5 sec. In the most simple technique of redundancy reduction, the zero-order predictor, is used. Data is sampled in 1/8 sec intervals. A specification of the frame structure is given, and frame synchronization is discussed. A block diagram of the redundancy reduction device is shown, and its mission operation is reported. ESRO

N72-29170# Air Force Weapons Lab., Kirtland AFB, N.Mex.
SHELL FOR THE ILLIAC 4 Technical Report, 1 Oct. 1970 - 31 Aug. 1971
William A. Whitaker, Richard E. Durrett, and Reginald W. Clemens Mar. 1972 117 p
(ARPA Order 17446T)
(AD-740478; AFWL-TR-72-33) Avail: NTIS CSCL 09/2

A one-dimensional Lagrangian hydrodynamics computer code (SAP) and a two-dimensional Eulerian hydrodynamics computer code (SHELL) have been successfully written in the GLYPNIR language for the ILLIAC IV. Timing simulations suggest a speed 50 times that of a CDC 6600 for the GLYPNIR SHELL code. Author (GRA)

N72-29171# Naval Postgraduate School, Monterey, Calif.
THE DESIGN, DEVELOPMENT AND TRANSLATION OF GENERAL PURPOSE SOFTWARE FOR THE P3 C AIRCRAFT'S DIGITAL COMPUTER M.S. Thesis
Dennis Edward Ray Dec. 1971 79 p refs
(AD-741066) Avail: NTIS CSCL 09/2

The Navy has incorporated a modified UNIVAC 1830-A (CP 901 or ASQ/114) mini digital computer into its P3C aircraft. This ASQ/114 computer system is presently used only during aircraft testing and flying. In the near future, fifty or more of these digital systems will be operational and will sit virtually idle about 40% of the time. Hence, this project was undertaken to improve the computer utilization, and to provide the individual squadrons with an administrative computer capability. Six specific tasks leading to the implementation of a general purpose operating system have been undertaken: a feasibility study, development of a CP 901 translator, design and development of an assembler, design study of the bootstrapping technique, design of a FORTRAN compiler, and the design of a control operating system. Author (GRA)

N72-29316* National Aeronautics and Space Administration. Mississippi Test Facility, Bay Saint Louis.
SUMMARY OF 1971 PATTERN RECOGNITION PROGRAM DEVELOPMENT
Sidney Lanier Whitley *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 33 p (For availability see N72-29302 20-13)
CSCL 09B

N72-29338* Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.
DATA PROCESSING AT THE UNIVERSITY OF KANSAS
Robert M. Haralick *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 33 p refs Original contains color illustrations (For availability see N72-29327 20-13)
CSCL 09B

N72-29342* South Dakota State Univ., Brookings. Remote Sensing Inst.
PATTERN RECOGNITION SYSTEM AND PROCEDURES
Gerald D. Nelson and David V. Serreyn *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 21 p refs (For availability see N72-29327 20-13)
CSCL 09B

N72-29343* Colorado School of Mines, Golden. Geology Dept.
BONANZA PROJECT, 1971
Keenan Lee *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 23 p (For availability see N72-29327 20-13)
CSCL 09C

N72-29344* Texas A&M Univ., College Station. Remote Sensing Center.
A COACTIVE INTERDISCIPLINARY RESEARCH PROGRAM WITH NASA
John W. Rouse, Jr. *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 29 p (For availability see N72-29327 20-13)
CSCL 09B

N72-29350* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
DATA PROCESSING 1: ADVANCEMENTS IN MACHINE ANALYSIS OF MULTISPECTRAL DATA
Philip H. Swain *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 13 p refs (For availability see N72-29327 20-13)
(Grant NGL-15-005-112)
CSCL 09B

N72-29351* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
DATA PROCESSING 2: ADVANCEMENTS IN LARGE SCALE DATA PROCESSING SYSTEMS FOR REMOTE SENSING
David Landgrebe *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 31 p (For availability see N72-29327 20-13)
(Grant NGL-15-005-112)
CSCL 09B

N72-29412* Agricultural Research Service, Weslaco, Tex. Soil and Water Conservation Research Div.
DISCRIMINANT ANALYSES OF BENDIX SCANNER DATA
A. J. Richardson, C. L. Wiegand, R. W. Leamer, A. H. Gerbermann, and R. J. Torline *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 22 p refs (For availability see N72-29407 20-13)
CSCL 09B

N72-29415* Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.
PATTERN RECOGNITION OF NATIVE PLANT COMMUNITIES: MANITOU COLORADO TEST SITE
Richard S. Driscoll *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 28 p refs Original contains color illustrations (For availability see N72-29407 20-13)
CSCL 09B

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N72-29172* Virginia Univ., Charlottesville.
THIN FILM MICROWAVE IRIS Patent
Robert L. Ramey, Hugh S. Landes, and Eugene A. Manus, inventors (to NASA) Issued 11 Jul. 1972 3 p Filed 28 May 1970 Supersedes N70-35416 (19 - 09, p 3514) Sponsored by NASA
(NASA-Case-LAR-10511-1; US-Patent-3,676,809; US-Patent-Appl-SN-41345; US-Patent-Class-333-98R; US-Patent-Class-333-24R; US-Patent-Class-333-98P) Avail: US Patent Office CSCL 09A

A thin film microwave iris including an aperture, inside a microwave waveguide transverse to the flow of microwave energy in the waveguide with the thin film electrically connected to the walls of the waveguide is described. Due to the flow of energy through the film as well as through the aperture, the characteristics of thin film irises are different from the characteristics of conventional irises.
Official Gazette of the U.S. Patent Office

N72-29173*# Princeton Univ. Observatory, N.J.
DEVELOPMENT OF TELEVISION TUBES FOR THE LARGE SPACE TELESCOPE
John L. Lowrance and Paul Zucchino 1971 35 p refs Presented at Intern. Conf. on Space Applications of Camera Tubes, Paris, 23-25 Nov. 1971
(Contract NSR-31-001-127; Grant NGR-31-001-236)
(NASA-CR-127794) Avail: NTIS HC $3.75 CSCL 09A

Princeton Observatory has been working for several years under NASA sponsorship to develop television type sensors to use in place of photographic film for space astronomy. The performance of an SEC-vidicon with a 25 mm x 25 mm active area, MgF2 window, and bi-alkali photocathode is discussed. Results from ground based use on the Coude spectrograph of the 200-inch Hale telescope are included. The intended use of this tube in an echelle spectrograph sounding rocket payload and on Stratoscope 2 for direct high resolution imagery is also discussed. The paper also discusses the large space telescope image sensor requirements and the development of a larger television tube for this mission. Author

N72-29174*# Connecticut Univ., Storrs. Dept. of Electrical Engineering.
A NOTE ON POLE ASSIGNMENT
B. Sridhar and D. P. Lindorff Apr. 1972 10 p refs
(Grant NGL-07-002-002)
(NASA-CR-127763; TR-72-2) Avail: NTIS HC $3.00 CSCL 09C

It is shown that for a controllable, linear time invariant multivariable system at least max (m,p) poles can be assigned arbitrarily. In certain cases more than max (m,p) poles can be assigned. This result is particularly useful in designing systems for high integrity in the event of transducer failure. In such an event this design takes advantage of the unequal number of inputs and outputs so as to assure no loss in pole assignability. Author

N72-29175*# Hawaii Univ., Honolulu.
USING INTERACTIVE SYSTEMS AS A TOOL IN CREATING INTERACTIVE SUBSYSTEMS
Vincent J. Nicholson and Charlie C. Bass Feb. 1972 7 p refs
(Contracts NAS2-6700; F44620-69-C-0030; AF Proj. 9558; Proj. Themis)
(NASA-CR-127737; AFOSR-72-0470TR; AD-737743; A72-1) Avail: NTIS CSCL 09/2

One of the principal functions of an interactive system is the facility to create an interactive subsystem. That is, to use the general facilities of the primary system to build a secondary or subsystem which projects attributes appropriate to a specific task. In this way, for instance, a library serial maintenance procedure can be provided on a remote computer terminal which is connected solely to a BASIC timesharing system. The process of creating such a subsystem is a distinctive one, due to the inherent nature of man-machine interaction. It becomes even more interesting when the subsystem creation process is a group effort. This paper is the description, partial analysis and evaluation of such a group project. The effects of using interactive systems for such projects are of growing interest. This paper attempts to point out some of the positive and negative factors that must be reckoned within such an environment. Author (GRA)

N72-29176# National Bureau of Standards, Washington, D.C.
TABULATION OF PUBLISHED DATA ON ELECTRON DEVICES OF THE USSR THROUGH DECEMBER 1971
Charles P. Marsden Jun. 1972 110 p Supersedes NBS-TN-526
(NBS-TN-715; NBS-TN-526) Avail: SOD $1.00 as C 13.46:715

This tabulation includes data on U.S.S.R. electron devices as collected from publications, mostly handbooks, published by the various ministries and institutes of the U.S.S.R. Information is given on all active devices ranging from receiving to microwave devices, semiconductor devices, and miscellaneous

devices suvh as photographic flash tubes and thermistors.
Author

N72-29177# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et de ses Applications Spatiales.
BOOLEAN FUNCTION AND MULTIPLE FAULT TESTING [FONCTION BOOLEENNE ET TEST DES PANNES MULTIPLES]
J. P. Richard 8 May 1972 32 p refs In FRENCH Presented at the IMAG Seminar, Grenoble, France, 8 May 1972
(Publ-901) Avail: NTIS HC $3.75

A method for detecting multiple faults in combinational circuits is described. These circuits are composed exclusively of AND, OR, NOT, NOR, gates. Tree circuits, for which it is sufficient to know the function performed to design test algorithms, are discussed. General circuits are then considered. These are transformed into an equivalent tree circuit. The algorithms are applied to monotone functions. Design of circuits that can easily be tested is discussed. ESRO

N72-29178# Marconi Co., Ltd., Chelmsford (England). Research Div.
DEFINITION STUDY FOR PCM/PSK/TDMA TEST EQUIPMENT FOR THE MODULAR REPEATER. VOLUME 1: TECHNICAL ASPECTS Final Report
1 May 1972 69 p
(Contract ESTEC-1579/72-SW)
(ESRO-CR(P)-102-Vol-1) Avail: NTIS HC $5.50

A specification and possible equipment configuration is given for a 60 to 80 Mbits/sec PCM/PSK/TDMA test equipment for an ESRO communication satellite modular repeater. The test facility is capable of assessing the performance of satellite repeater breadboard models, currently being developed as part of the European communication satellite program, when transmitting digitally modulated signals. The particular signal characteristics envisioned are those appropriate to the PCM/PSK/TDMA modulation/multiple access methods which have been identified as preferred techniques for the proposed system. The test equipment is flexible in capability. Operation at a range of signalling speeds is necessary and facilities are provided for introducing adjacent and co-channel interfering signals. ESRO

N72-29179# Radio Corp. of America, Princeton, N.J. Advanced Technology Lab.
GUNN EFFECT MICROWAVE POWER SOURCE Interim Report, 1 Mar. - 30 Sep. 1971
S. Yegna Narayan and John P. Paczkowski Mar. 1972 36 p refs
(Contract DAAB07-71-C-0135; DA Proj. 1S6-62705-A-056)
(AD-740223; ECOM-1035-1) Avail: NTIS CSCL 09/1

The first phase of a research program aimed at developing high power-high efficiency cw transferred electron oscillators (TEOs) in X-band is described. The program goals are an output power of 1.5 watts with 6% efficiency. A thermal analysis of a typical TEO structure was carried out. The influence of various device design parameters such as heat sink thermal conductivity, device diameter, single and dual heat sink configurations and nl product on device efficiency were studied. Based on the guidelines generated by this study, a new device fabrication technology was developed and is being debugged. Preliminary results from plated heat sink devices are described.
Author (GRA)

N72-29180# Sprague Electric Co., North Adams, Mass.
HIGH ENERGY CAPACITORS FOR MODERATE REPETITION RATE Semiannual Report, 30 Oct. 1970 - 30 Jun. 1971
Conrad Halberg and Herbert Rice Feb. 1972 59 p
(Contract DAAB07-71-C-0049; DA Proj. 1S6-62705-A-057)
(AD-740222; ECOM-0049-1) Avail: NTIS CSCL 09/1

Capacitors of various designs were constructed and measured for capacitance, dissipation factor and leakage current at various temperatures (-40 C, 25 C, 40 C, 85 C). Breakdown tests were conducted. Capacitors of various design were charge-discharge life tested for 100,000 cycles or failure. Two designs were selected for work in Phase II on the basis of the charge-discharge life test results. Special test equipment for charge-discharge evaluation testing (CADET III) was fabricated, installed and placed into use. Author (GRA)

N72-29181# Naval Research Lab., Washington, D.C.
THE DESIGN OF A TUNABLE NOTCH FILTER WITH VARIABLE Q Final Report
J. P. Letellier Mar. 1972 26 p ref
(AD-740744; NRL-MR-2405) Avail: NTIS CSCL 09/5

In electro-mechanical servo systems one often encounters undesired resonances which contribute to the system instability. One method used to combat such a resonance is to place a notch filter in the feedback loop to reduce gain at the resonance frequency, while allowing frequencies outside the notch to pass without appreciable phase shift or attenuation. The notch filter described in this paper is particularly useful in this application since it can be tuned to the resonant frequency while in the circuit, the Q can be adjusted to cover the resonance, and the notch attenuation can be adjusted for essentially zero transmission at the center frequency. The filter is of simple design and easily constructed. The most critical restriction is that the operational amplifiers used in the circuit be stable at unity gain. However, this is not particularly difficult to realize. Author (GRA)

N72-29182# Radio Corp. of America, Princeton, N.J.
Dc-ELECTROLUMINESCENT FLAT PANEL DISPLAY Quarterly Report, 1 Oct. - 31 Dec. 1971
Joseph J. Hanak, P. Neil Yocom, and J. Gordon Davy Fort Monmouth, N. J. ECOM Apr. 1972 29 p refs
(Contract DAAB07-69-C-0290; DA Proj. 1S6-62705-A-055)
(AD-740231; PRRL-72-CR-4; ECOM-0290-10; QR-10) Avail: NTIS CSCL 09/5

The report describes research on cells made of electroluminescent powder in an organic plastic matrix, where a brightness of 22 fL at 100 V is reached. Improvements in brightness and stability have been realized by a double coating of the ZnS:Mn powder with copper sulfide. Evaporated films of ZnS:Mn:Cu containing small amounts of aluminum have shown green electroluminescence, which might lead to higher brightness due to the favorable shift in the spectra. A cell made with a 1-micrometer-thick laser evaporated film of ZnS:2%Mn:03%Cu has shown a brightness of 25 fL at 65 V, which is the highest brightness that the authors have observed at this voltage to date. Co-sputtered films of (ZnS)(1-x)(SiO2)(x):Mn:Cu containing about 11 volume % silica have shown electroluminescence. This material is an inorganic film analogue of the powder-organic matrix cell. Author (GRA)

N72-29183# Radio Corp. of America, Somerville, N.J. Solid State Div.
BROADBAND COMBINABLE MODULE FOR UHF AMPLIFICATION Semiannual Report, 1 May - 1 Dec. 1971
John F. Locke Dec. 1971 44 p refs
(Contract DAAB07-71-C-0190; DA Proj. 1H6-62705-A-056)
(AD-741356; ECOM-0190-1) Avail: NTIS CSCL 09/5

Utilizing broadband stripline techniques, two TA7994 driver amplifiers were designed and constructed. The first amplifier, designed on teflon dielectric, provided 10 db plug or minus 0.9 dB power gain with 43 to 55 percent collector efficiency and a maximum input VSWR of 3.5:1 at 28 volts V sub and 1 watt input power from 620 to 960 megahertz. For a reduction in size, the second driver amplifier was produced on two 1 inch by 1 inch alumina dielectric substrates. The alumina amplifier produced 8.81 plus or minus 0.8 dB power gain and 35 to 51 percent collector efficiency at 28 volts V sub CC and 1 watt of input power. Author (GRA)

N72-29184# Radio Corp. of America, Princeton, N.J.
OPTOELECTRONIC ELECTRON EMITTER Semiannual Report, 15 Apr. - 31 Sep. 1971
Horst Schade, Herbert Nelson, and Henry Kressel Apr. 1972 31 p refs
(Contract DAAB07-71-C-0059)
(AD-741348; PRRL-71-CR-38; ECOM-0059-2) Avail: NTIS CSCL 09/1

A greatly improved cold-cathode emitter was developed based on the use of liquid-phase epitaxy, (AlGa)As-GaAs heterojunctions, and negative-electron-affinity GaAs surfaces. An important part of the device is the lateral confinement of the current flow to the desired emitting surface by a novel fabrication technique involving the selective diffusion of Zn. It was shown for the first time that III-V semiconductor cold-cathodes are capable of dc operation at efficiencies and emission-current densities of practical interest, and record values were obtained which exceeded the objectives of this program. Author (GRA)

N72-29185# Army Foreign Science and Technology Center, Charlottesville, Va.
APERTURE CHARACTERISTICS OF PHOTOELECTRIC DETECTORS
A. S. Gridin and E. D. Pankov 24 Apr. 1972 9 p Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Priborostr. (USSR), v. 11, no. 1, 1968 p 105-108
(AD-741113; FSTC-HT-23-461-70) Avail: NTIS CSCL 09/1

Measurements are discussed of the aperture characteristics of certain types of photodiodes and photoresistors. A schematic diagram of the measuring apparatus is given. Diagrams and graphs depicting the measurements are also given. GRA

N72-29186# Naval Research Lab., Washington, D.C.
ANALYSIS OF PHYSICAL PARAMETERS IN ELECTRON-BEAM IRRADIATED SEMICONDUCTOR DIODES Interim Report
George A. Haas 31 Mar. 1972 33 p refs
(RR0210346; XF52545011)
(AD-741205; NRL-7366) Avail: NTIS CSCL 09/1

The basic interaction theory of parameters such as thickness, impurity density, area, and external supply voltage required for various power-frequency applications is discussed for multiple electron-beam-irradiated semiconductor diodes connected in series. Two general approaches are outlined for use in CW class-B applications: (1) a minimum-thickness approach for reducing the transit-time limitations for a tuned-output high-frequency type of operation, and (2) a minimum-area approach for reducing the diode capacitance, as is desired for wide-bandwidth applications. Guidelines are also provided for changing the design conditions by altering constraints such as maximum allowed electric field, minimum allowed electric field, and heat dissipation. Author (GRA)

N72-29187# GTE Sylvania, Inc., Mountain View, Calif. Electro-Optics Organization.
INFRARED PHOTOCATHODE Annual Report, 1 May 1971 - 30 Apr. 1972
H. Sonnenberg 30 Apr. 1972 21 p refs
(Contract N00014-70-C-0079; ARPA Order 1806)
(AD-741260) Avail: NTIS CSCL 09/1

The amount of Cs-O low-work-function-surface material required to optimize the photoresponse of InAs(0.4)P(0.6) depends upon the wavelength at which the response is to be maximized. It is shown that the optimum thickness increases exponentially with wavelength. The effect of thick Cs-O layers on photoemission from GaAs and InAs(0.4)P(0.6) cathodes is experimentally investigated. Simple empirical relationships between the yield and thickness and between the escape probability and thickness are derived. GRA

N72-29188# Michigan Univ., Ann Arbor. Electron Physics Labs.
MICROWAVE SOLID-STATE DEVICE AND CIRCUIT STUDIES Quarterly Progress Report, 1 Jun. - 1 Sep. 1971
G. I. Haddad and W. R. Curtice Griffiss AFB, N. Y. RADC Jan. 1972 127 p
(Contract F30602-71-C-0099; AF Proj. 5573)
(AD-740602; RADC-TR-71-301; Rept-037250-4; AR-4) Avail: NTIS CSCL 09/1

This is the fourth quarterly report on subject contract whose objectives are to investigate theoretically and experimentally new solid-state phenomena and techniques having application to microwave generation, amplification, and control. Current tasks under this program are in the following: High-power Gunn-effect devices; gunn-effect amplifiers; modulation properties of gunn-effect devices; avalanche-diode amplifiers; high-efficiency avalanche diodes; nonlinear operating characteristics of IMPATT diodes; solid-state device fabrication; and, instabilities in germanium. Author (GRA)

N72-29189# General Electric Co., Philadelphia, Pa. Re-entry and Environmental Systems Div.
ADVANCED HARDENED ANTENNA WINDOW MATERIALS STUDY Final Report, 7 Dec. 1970 - 7 Nov. 1971
James P. Brazel Feb. 1972 83 p refs
(Contract DAAG46-71-C-0053; DA Proj. 1B0-62113-A-661)
(AD-741384; Rept-72SD2054; AMMRC-CTR-72-1) Avail: NTIS CSCL 11/4

A hardened composite antenna window material designated ADL-10 was developed, based on GE-RESD's Omniweave multidirectional fiber reinforcement woven construction using pure silica fibers and GE SR-350 methyl silicone resin as the matrix. An inorganic silica/silica composite designated Markite and derived from multiple pyrolyses and reimpregnation of ADL-10 was studied for antenna window use at heat flux levels above 100 Btu/sq. ft. sec. GRA

N72-29190# Radio Corp. of America, Somerville, N.J. Solid State Div.
LONG-LIFE, BROADBAND, COMMON-BASE, 30 TO 80 MHz VHF STAGES Interim Report, 16 Feb. - 30 Sep. 1971
Edward W. Lau and L. J. Holmquest Feb. 1972 35 p
(Contract DAAB07-71-C-0139; DA Proj. 1H6-62705-A-056)
(AD-740225; ECOM-0139-1) Avail: NTIS CSCL 09/1

Most effort during the reporting period was directed toward the fabrication of devices, measurement of transistor input and collector load impedances, and the design and development of common-base broadband amplifiers. Two 30- to 80-megahertz common-base broadband amplifiers, a 10-watt single-ended and a 40-watt push-pull, were constructed. Broadband transmission line transformers were also employed as input and output matching networks in both amplifiers. Results show that stable operation in the VHF range can be achieved in broadband 30- to 80-megahertz common-base amplifiers under matched load conditions. Author (GRA)

N72-29191# Honeywell, Inc., Lexington, Mass.
MERCURY CADMIUM TELLURIDE 10.6-MICRON PHOTODIODE Semiannual Report, 15 May - 15 Nov. 1971
Alan B. Timberlake and Donald A. Soderman Apr. 1972 65 p refs
(Contract DAAB07-71-C-0236)
(AD-741840; ECOM-0236-1) Avail: NTIS CSCL 09/1

Improvements were made in the junction technology required for sensitive, high-speed mercury cadmium telluride (Hg,Cd)Te, photodiode detectors that operate at 77 K. Effort was directed toward the investigation of surface etches, initiation of a planar junction technology, bulk material study, and detailed characterization of fabricated devices. The results of these investigations have been important contributions to the development of (Hg,Cd)Te photodiode detectors, optimized for 10.6-micron radiation. Author (GRA)

N72-29192# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
A LOW PROFILE ANTENNA FOR AIRBORNE STATION-KEEPING RADAR APPLICATIONS
Robert J. Mailloux and William G. Mavroides 13 Dec. 1971 43 p refs
(AF Proj. 4600)
(AD-741751; AFCRL-PSRP-473; AFCRL-72-0046) Avail: NTIS CSCL 17/9

The report describes the array of eight channel guide antennas designed to replace the directional antenna for the AN/APN-169 Aircraft Station Keeping System. Design data are given for the individual channel guide elements. The report invludes the results of an extensive experimental program undertaken to evaluate the radiation properties of the elements alone, or in the array. Author (GRA)

N72-29193# Raytheon Co., Bedford, Mass. Missile Systems Div.
INVESTIGATION OF THE ELEMENT PATTERN IN CYLINDRICAL PHASED ARRAYS OF CIRCULAR WAVE-GUIDES
Quirino Balzano Mar. 1972 55 p refs
(Contract F19628-70-C-0226; AF Proj. 4600)
(AD-742327; BR-6959; AFCRL-72-0232; SR-3) Avail: NTIS CSCL 09/5

The radiation from the elements in a cylindrical phased array is analyzed theoretically and experimentally. The theoretical investigation has developed a multimodal analysis method for cylindrical arrays. The method is similar to that for plane arrays, whereby, the field inside the element is represented as the superposition of a set of waveguide modes. The method allows the definition and the precise evaluation of the driving point admittance of the elements. A comparison between the driving point admittance in planar and cylindrical arrays is made and the conditions for the use of Wheeler simulators for cylindrical array element design are set. Author (GRA)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories.

N72-29194*# Alabama Univ., University.
THE USE OF LINEAR PROGRAMMING TECHNIQUES TO DESIGN OPTIMAL DIGITAL FILTERS FOR PULSE SHAPING AND CHANNEL EQUALIZATION
Ronald C. Houts and Donald W. Burlage 19 May 1972 168 p refs
(Contract NAS8-20172)
(NASA-CR-123744; TR-142-102) Avail: NTIS HC $10.50 CSCL 09C

A time domain technique is developed to design finite-duration impulse response digital filters using linear programming. Two related applications of this technique in data transmission systems are considered. The first is the design of pulse shaping digital filters to generate or detect signaling waveforms transmitted over bandlimited channels that are assumed to have ideal low pass or bandpass characteristics. The second is the design of digital filters to be used as preset equalizers in cascade with channels that have known impulse response characteristics. Example designs are presented which illustrate that excellent waveforms can be generated with frequency-sampling filters and the ease with which digital transversal filters can be designed for preset equalization. Author

N72-29195*# Massachusetts Inst. of Tech., Cambridge. Decision and Control Sciences Group.
ADAPTIVE CONTROL OF STOCHASTIC LINEAR SYSTEMS WITH UNKNOWN PARAMETERS M.S. Thesis
Richard Tse-Min Ku May 1972 148 p refs
(Grants NGL-22-009-124; AF-AFOSR-1941-70; AF-AFOSR-2273-72)
(NASA-CR-127786; ESL-R-477) Avail: NTIS HC $9.50 CSCL 09C

The problem of optimal control of linear discrete-time stochastic dynamical system with unknown and, possibly, stochastically varying parameters is considered on the basis of noisy measurements. It is desired to minimize the expected value of a quadratic cost functional. Since the simultaneous estimation of the state and plant parameters is a nonlinear filtering problem, the extended Kalman filter algorithm is used. Several qualitative and asymptotic properties of the open loop feedback optimal control and the enforced separation scheme are discussed. Simulation results via Monte Carlo method show that, in terms of the performance measure, for stable systems the open loop feedback optimal control system is slightly better than the enforced separation scheme, while for unstable systems the latter scheme is far better. Author

N72-29196*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
OPTIMAL CONTROL OF FIRST ORDER DISTRIBUTED SYSTEMS Ph.D. Thesis
Timothy L. Johnson May 1972 179 p refs
(Grant NGL-22-009-124; NSF GK-25781)
(NASA-CR-127799; ESL-R-482) Avail: NTIS HC $11.00 CSCL 09C

The problem of characterizing optimal controls for a class of distributed-parameter systems is considered. The system dynamics are characterized mathematically by a finite number of coupled partial differential equations involving first-order time and space derivatives of the state variables, which are constrained at the boundary by a finite number of algebraic relations. Multiple control inputs, extending over the entire spatial region occupied by the system ('distributed controls') are to be designed so that the response of the system is optimal. A major example involving boundary control of an unstable low-density plasma is developed from physical laws. Author

N72-29197# Sandia Labs., Livermore, Calif. Electromechanical Components Div.
CIRCUIT RESISTANCE OF PERMANENTLY MATED ITEMS
Joseph A. Teresi Mar. 1972 15 p
(SC-TM-720139) Avail: NTIS

A summary is presented of four studies concerned with circuit resistance of permanently mated connections. The results indicate that the changes in resistance of such connections are virtually undetectable and, therefore, are of no importance when considering degradation of items in stockpile. Author

N72-29198# Sandia Labs., Albuquerque, N.Mex.
CIRCUIT ANALYSIS USING THE DRIVING-POINT-IMPEDANCE TECHNIQUE
Thomas A. Howard Feb. 1972 72 p refs Sponsored by AEC
(SC-M-710896) Avail: NTIS

The use of driving point impedance (DPI) to design electronic circuits, solve circuit problems, and study circuit operation is discussed. The DPI method simplifies the writing of transfer functions and requires only a single active device model for all transistor circuits. The use of the Laplace transform method along with DPI analysis to solve transient circuit problems is examined. E.H.W.

N72-29199# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et de ses Applications Spatiales.
STUDY OF RECURRENCE RELATIONSHIPS AND THEIR APPLICATIONS BY THE LABORATOIRE D'AUTOMATIQUE ET DE SES APPLICATIONS SPATIALES
J. Lagasse and C. Mira [1971] 14 p refs

(LAAS-Publ-913) Avail: NTIS HC $3.00

The results concerning the properties of the recurrence relationships' solutions are analyzed. Data cover (1) recurrent solutions in the Birkhoff sense, (2) definition of the stationary states and their stability, (3) stability domain of a stable stationary state, (4) critical stability cases in the Liapunov sense, (5) qualitative behavior changes due to a parameter variation, and (6) stability theorem for autonomous and non-autonomous recurrence relationships. Author (ESRO)

N72-29200# Stanford Univ., Calif. Electronics Lab.
[ELECTRONIC EQUIPMENT AND COMPONENTS, AND INFORMATION AND DIGITAL SYSTEMS] Semiannual Status Report, 1 Jul. - 31 Dec. 1971
31 Dec. 1971 101 p refs
(Contract N00014-67-A-0112-0044)
(AD-739707; SU-SEL-72-002; SASR-121) Avail: NTIS CSCL 14/2

Contents: Plasma physics and quantum electronics; Radioscience; Integrated circuits; Solid state; Information systems; Digital systems. GRA

N72-29201# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDY OF THE TIME CHARACTERISTICS OF THE ELECTRICAL BREAKDOWN OF SHORT GAS GAPS IN THE NANOSECOND TIME RANGE
Yu. I. Bychkov and G. S. Korshunov 11 Jan. 1972 13 p refs
Transl. into ENGLISH from Izv. Politekhn. Inst. (Tomsk), no. 162, 1967 p 180-185
(AD-740366; FTD-HT-23-1126-71) Avail: NTIS CSCL 14/2

Delay and switching times were studied in the static and pulse breakdown of the short (0.05 - 2.2 mm) gas gaps within the nanosecond range. Given statistic delay was measured at E equals 300 - 1400 kV/cm, when the efficient electrons are supplied by autoemission from the cathode. The average given statistic delay was found to decrease sharply with the decrease in pressure and to be 0.7 nsec. at 20 mm Hg; a given time at E equals 300 kV/cm decreased from 1400 to 1 nsec, with the increase in the length of discharge gap from 0.02 to 0.08 cm. GRA

N72-29202# IIT Research Inst., Chicago, Ill. Reliability Analysis Center.
MICROCIRCUIT RELIABILITY BIBLIOGRAPHY
B. A. Petersen Apr. 1972 430 p refs
(Contract F30602-72-C-0183)
(AD-740131; RAC-MRB-0472) Avail: NTIS CSCL 09/5

The bibliography identifies literature pertinent to the reliability conscious microelectronic device industry. The publication contains complete bibliographic information with abstracts for over 2,200 references. Citations include government R and D contract reports, failure analysis reports, reliability (laboratory and field) reports, symposia, proceedings and open literature. Author (GRA)

N72-29203# Naval Postgraduate School, Monterey, Calif.
MULTIFAULT ISOLATION IN LINEAR NETWORKS BY THE METHOD OF JOINT SIGNATURE M.S. Thesis
Gary Lamour Long Dec. 1971 54 p refs
(AD-741118) Avail: NTIS CSCL 09/5

A study was made to isolate one and two component faults in simple linear networks by the method of joint signature of order two whereby two measurements of a failed network are coded to all possible combinations of two component values which will produce that fault with all other elements at nominal value. Two additional measurements were obtained, a new joint signature of order two generated, and the faulty component set was selected as the fault pair with the same values at both joint signatures. The method involves numerous solutions of sets of nonlinear equations. By assuming many values of a failed network function the equations were presolved on a one time only basis for a network. One and two component faults were simulated in two simple low pass filter networks. the highest success rate in isolating faults was approximately 80%. Author (GRA)

N72-29204# Harvard Univ., Cambridge, Mass.
NETWORKING AND GRAPHICS RESEARCH Final report, 1 Jul. 1968 - 31 Aug. 1971
Hanscom Field, Mass. ESD Dec. 1971 74 p refs
(Contract F19628-71-C-0174; ARPA Order 952)
(AD-742252; ESD-TR-72-126) Avail: NTIS CSCL 09/2

The report describes the results of the program of research carried out at Harvard University utilizing the PDP-1-based graphics facility, the PDP-10, and the ARPA Network. Projects undertaken range from development of techniques for graphic input and display and development of graphics applications, to development of a programming system intended as a tool for attacking difficult programming projects and suitable for use concurrently at several nodes of the ARPA Network on a common computational task, and to development of programs specific to use of the ARPA Network and file transfer techniques. This report references various published papers and technical reports which contain more detailed accounts of the work undertaken. Author (GRA)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N72-29205*# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
HOLLOW CATHODE, QUASI-STEADY MPD ARC
N. Parmentier and R. G. Jahn Dec. 1971 71 p refs
(Grant NGL-31-001-005)
(NASA-CR-127749; Rept-1023) Avail: NTIS HC $5.75 CSCL 14B

A quasi-steady MPD accelerator has been operated with four different hollow cathodes over a power range from 5 kilowatts to 5 megawatts. The absolute level of the argon mass flow, as well as the fractional division of the flow between the cathode and the six standard chamber injectors, is varied over a range of 1 to 12 grams per second. For a fixed total current, it is observed that the voltage increases monotonically with mass flow rate, compared to the usual experience with solid cathodes where the voltage decreases with mass flow rate. For a fixed percentage of flow through the cathode, each hollow cathode configuration displays a minimum impedance at a particular value of the total mass flow. It is asserted that in order to keep the discharge inside the hollow cathode the magnetic pressure and gasdynamic pressure have to match inside the cavity. Author

N72-29206*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PERFORMANCE AND OPERATING CHARACTERISTICS OF THE ARC-DRIVEN LANGLEY 6-INCH SHOCK TUBE
John E. Nealy Washington Aug. 1972 28 p refs
(NASA-TN-D-6922; L-8312) Avail: NTIS HC $3.00 CSCL 14B

Performance characteristics for the arc-driven Langley 6-inch shock tube were determined for driver energies from 0.62 to 5 MJ. Voltage, current, and pressure histories of the arc driver were recorded, and driver efficiencies were determined from measured shock velocities. Time-resolved spectra for test gases of air, carbon monoxide, xenon, and a mixture of 80 percent helium and 20 percent hydrogen are presented. Author

N72-29207*# North Carolina State Univ., Raleigh. Center for Acoustical Studies.
DEVELOPMENT AND EVALUATION OF A DEVICE TO SIMULATE A SONIC BOOM
L. C. Rash, R. F. Barrett, and F. D. Hart May 1972 58 p refs
(Grant NGL-34-002-095)
(NASA-CR-112117) Avail: NTIS HC $5.00 CSCL 14B

A device to simulate the vibrational and acoustical properties of a sonic boom was developed and evaluated. The design employed a moving circular diaphragm which produced pressure variations by altering the volume of an air-tight enclosure that was located adjacent to an acoustical test chamber. A review of construction oriented problems, along with their solutions, is presented. The simulator is shown to produce the effects of sonic booms having pressure signatures with rise times as low as 5 milliseconds, durations as short as 80 milliseconds, and overpressures as high as 2.5 pounds per square foot. Variations in the signatures are possible by independent adjustments of the simulator. The energy spectral density is also shown to be in agreement with theory and with actual measurements for aircraft. Author

N72-29208*# California Univ., Los Angeles. Plasma Physics Group.
CURRENT DRIVEN ELECTROSTATIC AND ELECTROMAGNETIC ION CYCLOTRON INSTABILITIES
D. W. Forslund (Los Alamos Scientific Lab.), C. F. Kennel, and J. M. Kindel (Princeton Univ.) Feb. 1971 17 p refs
(Grant NGL-05-007-190; Contracts N00014-69-A-0200-4023; AT(04-3)-34; Grant NSF GP-22817; Proj. 157)
(NASA-CR-127752; R-87) Avail: NTIS HC $3.00 CSCL 14B

Growth rates and parameter dependences are calculated for the current driven instabilities of electrostatic (with finite-beta corrections) and electromagnetic ion cyclotron waves. For 0.25 < (T sub e)/(T sub i) < 2.5, ion cyclotron waves have large growth rates, while ion acoustic waves are still stable. In fusion devices, where electrostatic waves may be stable, electromagnetic ion cyclotron waves are unstable for beta sub i > 0.001.
Author

N72-29209*# California Univ., Los Angeles. Dept. of Physics.
SPATIAL CYCLOTRON DAMPING
Craig L. Olson Sep. 1970 30 p refs
(Grant NGR-05-007-190; Contracts N00014-69-A-0200-4023; AT(04-3)-34; Grant NSF GP-6817)
(NASA-CR-127770; R-78) Avail: NTIS HC $3.50 CSCL 14B

To examine spatial electron cyclotron damping in a uniform Vlasov plasma, it is noted that the plasma response to a steady-state transverse excitation consists of several terms (dielectric-pole, free-streaming, and branch-cut), but that the cyclotron-damped pole term is the dominant term for z > l = c/w sub ce provided (w sub pe/w sub ce) squared (c/a) is much greater than 1. If the latter inequality does not hold, then the free-streaming and branch-cut terms persist well past z = c/w sub ce as w sub 1 approaches w sub ce, making experimental measurement of cyclotron damping essentially impossible. Considering only (w sub pe/w sub ce) squared (c/a) is much greater than 1, it is shown how collisional effects should be estimated and how a finite-width excitation usually has little effect on the cyclotron-damped part of the response. Criteria is established concerning collisional damping, measurable damping length sizes, and allowed uncertainty in the magnetic field Beta. Results of numerical calculations, showing the regions in the appropriate parameter spaces that meet these criteria, are presented. From these results, one can determine the feasibility of, or propose parameter values for, an experiment designed to measure spatial cyclotron damping. It is concluded that the electron temperature T sub e should be at least 1 ev., and preferably 10 ev. or higher, for a successful experiment. Author

N72-29210# Association of Bay Area Governments, Berkeley, Calif.
AIRPORT NOISE AND LAND USE ANALYSIS
Paul K. Dygert, Judy A. Ungerer, and Fred L. Collins Mar. 1972 46 p refs Sponsored by HUD
Avail: NTIS HC $4.50

Two separate but related activities which were undertaken to provide a tool for the evaluation of changes in aircraft noise around airports are presented. The two activities involved, first, the development of extensive and detailed data on land uses around the three major air carrier airports in the area encompassed by the Regional Airport Systems Study; and, secondly, the creation of a computer-based system for manipulating the data so that it can be conveniently used for the study of alternative airport development plans. As inputs, the analysis uses the noise contours computed for the Regional Airport Systems Study and detailed land use data prepared by the Regional Airport Systems Study. The computer program for merging the land-use data and the noise contours is described. Author

N72-29211# Joint Publications Research Service, Arlington, Va.
AEROSOL CHAMBERS FOR ANIMALS
R. S. Gildenskiold et al 20 Jul. 1972 16 p refs Transl. into ENGLISH from Gigiena i Sanit. (Moscow), no. 3, 1972 p 79-86
(JPRS-56550) Avail: NTIS HC $3.00

Two studies are presented on factors of the microclimate of the 100 liter aerosol chambers and the development of a new model of aerosol chamber that would guarantee uniform dynamic dusting and continuous removal of the dust suspension. For individual titles, see N72-29212 through N72-29213.

N72-29212 Joint Publications Research Service, Arlington, Va.
A HORIZONTAL CHAMBER FOR CHRONIC PRIMING OF ANIMALS WITH FINE DUST AND WITH GASES
R. S. Gildenskiold *In its* Aerosol Chambers for Animals 20 Jul. 1972 p 1-7 refs (For availability see N72-29211 20-11)

The development of an aersol chamber designed to study the biological effects of chemically different aersols on an organism is discussed. The study was made in an attempt to establish hygienic norms for industrial air pollution at populated working points. The chamber is designed to: (1) permit control measurement of dust concentration and gas at any given point in the working area; (2) create optimum conditions for the survival of the animals; (3) provide visual observation of the animal; and (4) ensure access to the animals and provide for quick and easy cleaning of the premises. Experimental tests were made using white rats. Results show the aerosol chamber met all design specifications. E.H.W.

N72-29213 Joint Publications Research Service, Arlington, Va.
MAINTENANCE OF LABORATORY ANIMALS IN 100-LITER AEROSOL CHAMBERS DURING PROLONGED CHRONIC EXPERIMENT
V. A. Popov *In its* Aerosol Chambers for Animals 20 Jul. 1972 p 8-13 refs (For availability see N72-29211 20-11)

A systematic analysis was made of some of the microclimatic factors affecting rats in a 100 liter aerosol chamber during prolonged experiments. Efforts were also made to determine the validity of hygienic experiments made in such chambers. Since ammonia is a fundamental product of vital activity, its concentration level was used as a major index of air contamination. Results show the high ammonia levels found in such chambers indicate experiments may be invalid. It was determined that ammonia levels depend on type of animal, number of animals per unit of area, number of air exchanges, and the type of litter used. It was concluded that tests made with a 100 liter aerosol chamber are unfavorable for setting hygienic norms of atmospheric contamination, and that the chamber provides inadequate care for test animals. E.H.W.

N72-29214*# Teledyne ADCOM, Cambridge, Mass.
SIMULATION OF THE TDRS MULTIPATH ENVIRONMENT Multipath Signal Model Development
E. J. Baghdady, A. F. Ghais, and R. H. Wachsman Dec. 1970 57 p

(Contract NAS5-10797)
(NASA-CR-122508; TM-G-161-10) Avail: NTIS HC $5.00 CSCL 14B

Design principles and implementation methods are discussed for simulating the propagation path between a tracking and data relay satellite and a mission spacecraft. The emphasis is on multipath and Doppler simulation but additive disturbances are also considered. The recommended form of the simulator is fed separately with the unmodulated carrier, the unmodulated subcarriers (or spread-spectrum components) and the data signals. The perturbations are also introduced separately; then successive modulation operations are performed. The simulator is segmented into elements that perform the various functions of direct and specular multipath, diffuse fading, Doppler shift and delay spread. Delay spreads are realized by discrete delays operating on baseband signals. Doppler simulation and ionospheric or diffuse multipath fading are applied to individual paths before or after modulation of the carrier by delayed baseband signals. Block diagrams are presented on how the different elements are combined to create a complete channel simulator. Author

N72-29215# Adelaide Univ. (Australia). Dept. of Physics.
ULTRAVIOLET ION CHAMBER MEASUREMENTS OF THE SOLAR MINIMUM BRIGHTNESS TEMPERATURE
J. H. Carver, B. H. Horton, G. W. A. Lockey, and Bryan Rofe (Weapons Res. Estab., Salisbury, Australia) Feb. 1972 12 p refs
(ADP-111) Avail: AEC Depository Libraries

The solar ultraviolet flux in the wavelength bands 1580 to 1640 A and 1430 to 1470 A (FWHM) was measured using photon ion chambers carried on the satellite WRESAT I (1967-118A). These observations of the integrated ultraviolet flux from the entire disk indicated a value of (4570 + or - 50) K for the solar temperature minimum. The results are compared with other estimates of the minimum value of the solar brightness temperature. Author (NSA)

N72-29216# British Aircraft Corp. (Operating) Ltd., Bristol (England). Guided Weapons Technical Publications Dept.
COMPARATIVE STUDY OF ELECTRO-MAGNETIC TEST FACILITIES FOR GEOS Final Report
Jan. 1972 382 p refs
(Contract ESTEC-1439/71-SK)
(ESS/SS-319; ESRO-CR(P)-80) Avail: NTIS HC $21.25

The GEOS payload EMC requirements are analyzed and a baseline is provided against which test methods and techniques are evaluated. The ambient noise levels recorded at different world wide quiet sites are summarized. A catalog of European EMC test facilities and a list of commercial EMC test equipment are given. ESRO

N72-29217# National Physical Lab., Teddington (England). Metrology Centre.
RECOMMENDATIONS FOR THE DESIGN AND EQUIPPING OF ENGINEERING METROLOGY LABORATORIES
T. R. J. Oakley May 1972 24 p refs Revised
(NPL-MC-4-Rev) Avail: NTIS HC $3.25

Suggestions on size, site, general design features, atmospheric control, equipment, and other factors that affect the satisfactory functioning of an engineering metrology laboratory are given. A bibliography and a list of some suppliers of equipment is included. Author (ESRO)

N72-29218# Plessey Co., Ltd., Addlestone (England).
DEFINITION OF AEROSAT SIMULATION FACILITIES
G. H. Stephens, K. Simmons, and A. Wilsdon Apr. 1972 98 p refs
(Contract ESTEC-1346-71-CG)
(Rept-84/72/6; ESRO-CR(P)-104) Avail: NTIS HC $7.00

A definition is given of the simulation facilities to be provided at the Aeronautical Services Communication Center (ASCC) during the pre-operational evaluation of the aeronautical satellite system. Equipment is proposed for the simulator, and it includes an interface between the simulator and the ASCC, the display equipment, the processor, and its peripherals. The simulator is functionally partitioned in two parts, a ground user simulator and the remainder of the system, including mobiles. The use of two computers for the simulator is suggested. Three operator positions, a ground controller, a mobile controller, and a trials director, are proposed. Some tasks of these operators are examined. A functional analysis of the simulator and a provisional breakdown into software modules is given. Simulator functions for the communications evaluation are considered, and display requirements are analyzed. ESRO

N72-29219# Ballistic Research Labs., Aberdeen Proving Ground, Md. Exterior Ballistics Lab.
VACUUM EQUIPMENT USED IN THE BALLISTIC RESEARCH LABORATORIES' SUPERSONIC WIND TUNNELS
Howard A. Ricci Mar. 1972 30 p refs
(Contract DA Proj. 1T2-62301-A-201)
(AD-740741; BRL-MR-2159) Avail: NTIS CSCL 14/2

A pressure measuring facility is described with emphasis on adequacy of primary standard type devices for referencing all pressures of interest in wind tunnel testing. These devices are described and include commercially available and in-house fabricated systems. The lowest range standard is patterned on a similar National Bureau of Standards device. GRA

N72-29220# Honeywell, Inc., St. Paul, Minn. Systems and Research Center.
DISPLAY AND SYSTEM REQUIREMENTS FOR LOW-VISIBILITY FORMATION FLIGHT; SUMMARY OF RESULTS Final Report, Jun. 1966 - Jun. 1971
P. A. Anderson and M. L. Toivanen Apr. 1972 220 p refs
(Contract N00014-66-C-0362; NR Proj. 213-054)
(AD-740375; Honeywell-12543-FR8; JANAIR-710803) Avail: NTIS CSCL 05/8

A summary of results of an eight-phase, applied research program on low-visibility (IFR) formation flight display and system requirements is presented. The objective of this program was to define and validate through simulation total formation flight system concepts from the pilot's viewpoint. System characteristics and features that were investigated included: displays, display control laws, flight control, measurement systems, aircraft types, pilot skill acquisition, and system failures. Study results show comprehensively how manual formation flight system performance relates to various system element and operational characteristics. Steps to further validate and demonstrate the system concepts are suggested. Author (GRA)

N72-29221# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
SUBSONIC WIND TUNNEL FACILITIES
M. Alan Kidd Jan. 1972 29 p
(AD-741213; ASED-1186; NSRDC-3782) Avail: NTIS CSCL 14/2

Subsonic facilities available at the Naval Ship Research and Development Center (NSRDC) include two 8- by 10-foot general-purpose wind tunnels, a 15- by 20-inch research wind tunnel, and a vertical test facility. This report describes these facilities, some of the associated test support equipment, and the personnel services available at NSRDC. Procedures are included to indicate how potential users may arrange for test and analysis services. Author (GRA)

N72-29222# Massachusetts Inst. of Tech., Cambridge. Charles Stark Draper Lab.
AIR CUSHION VEHICLE CONTROL SIMULATION. PROPOSED AMPHIBIOUS ASSAULT LANDING CRAFT PROGRAM PLAN Final Report
Pierre Dogan Aug. 1971 164 p refs
(Contract N00600-71-C-0575)

(AD-740851; CSDL-R-698) Avail: NTIS CSCL 13/10

The report is a summary of simulation needs and recommendations specific to the current Navy Amphibious Assault Landing Craft (AALC) Program which is developing high speed amphibious air cushion vehicles (ACV). The recommendations fall within three categories: mathematical modelling, hybrid computer facility, and man-in-the-loop simulation. To a large extent the needs and recommendations presented here are applicable to other Navy programs as well, since many factors are common to any craft development program. Author (GRA)

N72-29223# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

A HYBRID COMPUTER PROGRAM TO COMPUTER SIMULATE A PILOT CONTROLLED AIRCRAFT Final Report

John Houtz Jan. 1972 101 p ref

(AF Proj. 8222)

(AD-740434; AFFDL-TR-71-71) Avail: NTIS CSCL 01/3

The program is specifically oriented for use on an EAI 8400 Hybrid Computing System that is operated by the Control Systems Development Branch (FGL), Air Force Flight Dynamics Laboratory (AFFDL), Air Force Systems Command (AFSC), Wright-Patterson Air Force Base, Ohio. The program is written in FORTRAN 4 computer language. Author (GRA)

N72-29224# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.

STING EFFECTS IN HYPERSONIC BASE PRESSURE MEASUREMENTS Test Report

George S. Pick Dec. 1971 24 p refs

(NSRDC Proj. 648-242; WR0090201)

(AD-741888; AL-85) Avail: NTIS CSCL 14/2

Sting interference effects were investigated at nominal Mach numbers of 6.3 and 9.9. Sting mounted and instrumented free flight sharp cone models were used at a unit Reynolds number of about 1,000,000/ft. Measurements showed that the base pressure distribution changes little below angle of attack 15 degrees but becomes highly nonuniform and sensitive to angle of attack changes at high angles of incidence. Sting interference effects are not very severe at M 6.3 when angle of attack is less than 20 degrees, but as the angle of attack increases, the flow becomes progressively more distorted. Consequently, the base pressure values of the sting mounted model deviate from the free flight interference free model measurements. Beyond about 40 degrees, due to the severe effects of sting interference, no steady base pressure value could be reached with the sting mounted model in either of the tested Mach numbers. For the free flight model at Mach number 9.9, the magnitude of the measured base pressure ratios at corresponding flow conditions and angles of attack were about 70 percent above the sting mounted model showing how serious sting interference can be. Author (GRA)

N72-29225# Edgerton, Germeshausen and Grier, Inc., Waltham, Mass. Environmental Equipment Div.

ADIABATIC SATURATION PSYCHROMETER AND ENVIRONMENTAL TEST CHAMBER Final Report, 10 Jan. 1970 - 7 Mar. 1972

Kenneth M. Cole 7 Mar. 1972 71 p refs

(Contract F19628-70-C-0232; AF Proj. 6682)

(AD-742331; AFCRL-72-0174) Avail: NTIS CSCL 14/2

The report covers the design, operation and performance of a heated-air adiabatic saturation psychrometer and an environmental test chamber developed for Air Force Cambridge Laboratories as a calibration standard for radiosondes. The system is semi-portable, and it operates from a 115V, 60Hz power. Author (GRA)

N72-29312* National Aeronautics and Space Administration. Mississippi Test Facility, Bay Saint Louis.

A SUMMARY OF ACTIVITIES OF THE EARTH RESOURCES LABORATORY AT THE MISSISSIPPI TEST FACILITY DURING 1971

Robert O. Piland *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 19 p (For availability see N72-29302 20-13)

CSCL 14B

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N72-29226*# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

LEADING-EDGE PRESSURE MEASUREMENTS OF AIRFOIL VORTEX INTERACTION

Robert G. Walsh, Jr. Jan. 1970 34 p refs

(Grant NGR-22-009-303)

(NASA-CR-112129; ASRL-TR-153-1) Avail: NTIS HC $3.75 CSCL 20D

Experimental pressure-differential measurements made at 10% chord of an airfoil-vortex interaction are presented. A line vortex was oscillated over an airfoil perpendicular to the span and parallel to the chord. The pressure time history was recorded in order to show the sharp pressure pulses resulting from the bursting of the vortex core as it impinges upon the airfoil. Results for various vortex sizes and free stream velocities were obtained. Measurements were also made when the airfoil was yawed to the line vortex. Maximum pressure differences were observed to occur in phase across the blade even with yaw, and were directly proportional to the square of the free stream velocity. The maximum dynamic pressure coefficients obtained were as high as 1.0 when vortex bursting occurred. Author

N72-29227*# Advanced Technology Labs., Inc., Jericho, N.Y.

UNSTEADY FLOW THROUGH COMPRESSOR STAGES

Edgar Alzner and John Erdos Dec. 1971 72 p refs

(Contract NASw-2057)

(NASA-CR-127765; ATL-TR-168) Avail: NTIS HC $5.75 CSCL 20D

The application of the nonsteady Lax-Wendroff technique to problems with asymptotically periodic solution which offers a potentially powerful method for the investigation of the interaction of rotating and stationary blade rows in turbomachinery is reported. A technique for specifying boundary conditions with phase lag was developed to accomplish this. A complete nonlinear analysis is carried out numerically to determine the entire flow field without recourse to the assumption of small disturbances of linear equations which underlie the previous acoustic theories. The result, obtained for the case of equal number of rotor and stator blades shows that transonic flow can be handled without difficulty. In addition, the program is not limited with regard to blade thickness, camber or loading. Extension of this method to incorporate viscous wakes and to analysis of fully three dimensional configuration is feasible, and would greatly expand its utility in practical applications. Author

N72-29228*# National Aeronautics and Space Administration, Washington, D.C.

NASA AIRCRAFT TRAILING VORTEX RESERACH

William A. McGowan 1971 44 p refs Presented at the FAA Symp. on Turbulence, Washington, D. C., 22-24 Mar. 1971

(NASA-TM-X-68566) Avail: NTIS HC $4.25 CSCL 20D

A brief description is given of NASA's comprehensive program to study the aircraft trailing vortex problem. Wind tunnel experiments are used to develop the detailed processes of wing tip vortex formation and explore different means to either prevent trailing vortices from forming or induce early break-up.

Flight tests provide information on trailing vortex system behavior behind large transport aircraft, both near the ground, as in the vicinity of the airport, and at cruise/holding pattern altitudes. Results from some flight tests are used to show how pilots might avoid the dangerous areas when flying in the vicinity of large transport aircraft. Other flight tests will be made to verify and evaluate trailing vortex elimination schemes developed in the model tests. Laser Doppler velocimeters being developed for use in the research program and to locate and measure vortex winds in the airport area are discussed. Field tests have shown that the laser Doppler velocimeter measurements compare well with those from cup anemometers. Author

N72-29229*# Boeing Co., Renton, Wash.
PREDICTION OF UNSTEADY AERODYNAMIC LOADINGS CAUSED BY TRAILING EDGE CONTROL SURFACE MOTIONS IN SUBSONIC COMPRESSIBLE FLOW: COMPUTER PROGRAM DESCRIPTION
M. C. Redman, W. S. Rowe, and B. A. Winther [1972] 207 p refs
(Contract NAS1-10536)
(NASA-CR-112015) Avail: NTIS HC $12.50 CSCL 20D

A digital computer program has been developed to calculate unsteady loadings caused by motions of lifting surfaces with trailing edge control based on the subsonic kernal function approach. The pressure singularities at hinge line and side edges have been extracted analytically as a preliminary step to solving the integral by collocation. The program calculates generalized aerodynamic forces for user supplied deflection modes. Optional intermediate output includes pressure at an array of points, and sectional generalized forces. From one to four controls on the half span can be accommodated. Author

N72-29230*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIQUID INFLOW TO A BAFFLED CYLINDRICAL TANK DURING WEIGHTLESSNESS
John V. Staskus Washington Aug. 1972 28 p refs
(NASA-TM-X-2598; E-6899) Avail: NTIS HC $3.00 CSCL 20D

An experimental investigation was conducted in which the behavior of liquid inflow to a cylindrical tank containing inlet baffles was observed during weightlessness. A single tank radius (2 cm), inlet radius (0.2 cm), and liquid (ethanol)were used. The inlet end of the tank was hemispherical with a 30 deg convergent inlet. All the baffle configurations tested were cylindrically symmetric and mounted coaxially with the tank within the hemispherical end. Both stable and unstable inflow behavior were observed using each baffle. It was found that, depending on which of the baffles was used, the critical inflow velocity at which a transition to unstable inflow began was from 2.5 to 12 times greater than the corresponding velocity in an unbaffled tank. Author

N72-29231*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF WALL COOLING AND ANGLE OF ATTACK ON BOUNDARY LAYER TRANSITION ON SHARP CONES AT FREE STREAM MACH 7.4
George G. Mateer Washington Aug. 1972 14 p refs
(NASA-TN-D-6908; A-4419) Avail: NTIS HC $3.00 CSCL 20D

Tests were conducted on 5 deg and 15 deg half-angle sharp cones at wall-to-total-temperature ratios of 0.08 to 0.4, and angles of attack from 0 deg to 20 deg. The results indicate that (1) transition Reynolds numbers decrease with decreasing temperature ratio, (2) local transition Reynolds numbers decrease from the windward to the leeward side of the model, and (3) transition data on the windward ray of cones can be correlated in terms of the crossflow velocity gradient, momentum thickness Reynolds number, local Mach number, and cone half-angle. Author

N72-29232*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL SOLUTIONS OF SEVERAL REFLECTED SHOCK-WAVE FLOW FIELDS WITH NONEQUILIBRIUM CHEMICAL REACTIONS
Ronald K. Hanson, Leroy L. Presley, and Elsie V. Williams Washington Aug. 1972 49 p refs
(NASA-TN-D-6885; A-4226) Avail: NTIS HC $3.00 CSCL 20D

The method of characteristics for a chemically reacting gas is used in the construction of the time-dependent, one-dimensional flow field resulting from the normal reflection of an incident shock wave at the end wall of a shock tube. Nonequilibrium chemical reactions are allowed behind both the incident and reflected shock waves. All the solutions are evaluated for oxygen, but the results are generally representative of any inviscid, nonconducting, and nonradiating diatomic gas. The solutions clearly show that: (1) both the incident- and reflected-shock chemical relaxation times are important in governing the time to attain steady state thermodynamic properties; and (2) adjacent to the end wall, an excess-entropy layer develops wherein the steady state values of all the thermodynamic variables except pressure differ significantly from their corresponding Rankine-Hugoniot equilibrium values. Author

N72-29233*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TURBULENT BOUNDARY-LAYER VELOCITY PROFILES ON A NONADIABATIC AT MACH NUMBER 6.5
Earl R. Keener and Edward J. Hopkins Washington Aug. 1972 48 p refs
(NASA-TN-D-6907; A-4240) Avail: NTIS HC $3.00 CSCL 20/4

Velocity profiles were obtained from pitot-pressure and total-temperature measurements within a turbulent boundary layer on a large sharp-edged flat plate. Momentum-thickness Reynolds number ranged from 2590 to 8860 and wall-to-adiabatic-wall temperature ratios ranged from 0.3 to 0.5. Measurements were made both with and without boundary layer trips. Five methods are evaluated for correlating the measured velocity profiles with the incompressible law-of-the-wall and the velocity defect law. The mixing-length generalization of Van Driest gives the best correlation. Author

N72-29234*# Translation Consultants, Ltd., Arlington, Va.
MEASUREMENT OF RAPIDLY VARYING HYDRAULIC FLOW RATES BY ULTRASONIC WAVES
P. Alais and J. C. Demarais Washington NASA Aug. 1972 30 p refs Transl. into ENGLISH of "Mesure de Debits Liquides Rapidement Variables au Moyen d'ondes Ultra-sonores", Rept. Onera-TP-10-78 Office Natl. d'Etudes et de Rech. Aerospatiale, 1972
(Contract NASw-2038)
(NASA-TT-F-14392; ONERA-TP-1078) Avail: NTIS HC $3.50 CSCL 20D

The study of unsteady phenomena in hydraulics implies the measurement of instantaneous flow rates of the liquids circulating in the pipes. It is desirable to add a minimum of perturbation in the circuits. This eliminates in practice all pressure drop devices or mobile mechanical parts. The method presented makes use of the convection phenomenon of an ultrasonic wave by the flow. After recalling the main methods in common use, the mechanical and electronic solutions retained are presented, as well as the results obtained with instruments of various capacities designed at ONERA. Author

N72-29235*# Scientific Translation Service, Santa Barbara, Calif.
NUMERICAL CALCULATION OF LAMINAR COMPRESSIBLE BOUNDARY LAYERS IN UNSTEADY FLOW
Jean Piquet Washington NASA Aug. 1972 23 p refs Transl. into ENGLISH from J. Mecan (Paris), v. 11, no. 1, 1972 p 5-27

(Contract NASw-2035)
(NASA-TT-F-14410) Avail: NTIS HC $3.25 CSCL 20D

Calculations of some velocity and temperature boundary layers on a flat plate, especially behind a shock, have been carried out. Such boundary layers have the following structure: two quasi-stationary flows, corresponding to known analytical solutions expressed in terms of similarity variables, merge in an interaction region. The governing equations in this region are singular-parabolic and admit boundary conditions generally associated with elliptic equations. These equations are solved successfully by a difference scheme converging in a suitable way. Author

N72-29236*# National Aeronautical Establishment, Ottawa (Ontario). Unsteady Aerodynamics Section.
STATIC AND DYNAMIC PITCHING MOMENT MEASUREMENTS ON A FAMILY OF ELLIPTIC CONES AT MACH NUMBER 11 IN HELIUM
K. Orlik-Rueckemann and J. G. LaBerge Jul. 1970 25 p refs
(Contract NASw-1947)
(NASA-CR-114482; LTR-UA-14) Avail: NTIS HC $3.25 CSCL 20D

Static and dynamic pitching moment measurements were made on a family of constant volume elliptic cones about two fixed axes of oscillation in the NAE helium hypersonic wind tunnel at a Mach number of 11 and at Reynolds numbers based on model length of up to 14 million. Viscous effects on the stability derivatives were investigated by varying the Reynolds number for certain models by a factor as large as 10. The models investigated comprised a 7.75 deg circular cone, elliptic cones of axis ratios 3 and 6, and an elliptic cone with conical protuberances. Author

N72-29237*# Virginia Polytechnic Inst., Blacksburg. Dept. of Aerospace Engineering.
FARFIELD STRUCTURE OF AN AIRCRAFT TRAILING VORTEX, INCLUDING EFFECTS OF MASS INJECTION
William Henry Mason and James Franklin Marchman, III Apr. 1972 161 p refs
(Grant NGL-47-004-067)
(NASA-CR-62078) Avail: NTIS HC $10.25 CSCL 20D

Wind tunnel tests to predict the aircraft wake turbulence due to the tip trailing vortex are discussed. A yawhead pressure probe was used in a subsonic wind tunnel to obtain detailed mean flow measurements at stations up to 30 chordlengths downstream in an aircraft trailing vortex. Mass injection at the wingtip was shown to hasten the decay of the trailing vortex. A theoretical method is presented to show the effect which the circulation distribution on the wing has on the structure of the outer portion of the vortex. Author

N72-29238*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIQUID INFLOW TO INITIALLY EMPTY CYLINDRICAL TANKS IN LOW GRAVITY
Charles M. Spuckler Washington Aug. 1972 22 p refs
(NASA-TM-X-2613; E-6969) Avail: NTIS HC $3.00 CSCL 20D

An experimental investigation was performed to determine the characteristics of liquid inflow to initially empty cylindrical tanks in a low gravity environment. The acceleration was varied so that Bond numbers based on the inlet radius varied from 0.059 to 2.80. The liquid entered the tank as a jet that grew to a maximum height and then decreased in height with respect to the bottom of the tank, with the liquid from the jet collecting in the bottom of the tank. The maximum jet heights were correlated in terms of the Weber number and the Bond number. Author

N72-29239# Kyoto Univ. (Japan).
ON ENTROPY IN NONEQUILIBRIUM NOZZLE FLOWS OF VIBRATIONALLY RELAXING DIATOMIC GASES
Ryuji Ishii 15 Aug. 1972 43 p refs Backup document for AIAA Synoptic scheduled for publication in AIAA Journal on Jan. 1973
Avail: NTIS HC $4.25

A close investigation on entropy in nonequilibrium nozzle flows of vibrationally relaxing diatomic gases is made. It is generally concluded that increasing entropy in subsonic regions between the stagnation and critical points decreases the critical mass flows. So long as the flows start from the equilibrium reservoirs, the maximum critical mass flow for the vibrationally relaxing diatomic gas under the fixed reservoir conditions is the frozen one, while the minimum is the one which is somewhat smaller than the equilibrium due to the effect of increasing entropy. A new criterion for the validity of the equilibrium-frozen flow approximation is also proposed. This is closely related to the roles of entropy in nonequilibrium nozzle flows. Finally the effects of the entropy rise on asymptotic behaviors of flows far downstream of a throat are examined. All these analyses are based on basic equations which were previously derived. Author

N72-29240# Sandia Labs., Albuquerque, N.Mex.
CHARACTERISTICS OF A LAMINAR BOUNDARY LAYER ON A SPINNING TANGENT OGIVE CYLINDER AT ANGLE OF ATTACK
H. R. Vaughn and O. L. George, Jr. Mar. 1972 51 p refs
(SC-RR-710851) Avail: NTIS

Streamline velocity profiles of a laminar boundary layer were determined from pitot pressure measurements made in a supersonic wind tunnel on a spinning ogive cylinder at zero and four degrees angle of attack. A transformation was found which transforms the velocity profiles to be in agreement with the incompressible Blasius profile. Author

N72-29241# Los Alamos Scientific Lab., N.Mex.
EXPERIMENTAL PERFORMANCE OF SUPERSONIC NOZZLES USING LITHIUM VAPOR AS A PROPELLANT
D. J. Roehling, T. F. Stratton, and D. B. Fradkin [1972] 6 p refs Presented at 9th Elec. Propulsion Conf., Bethesda, Md., 17 Apr. 1972 Sponsored by AEC
(LA-DC-72-221) Avail: NTIS

A possible way of increasing the specific impulse of electrothermal thrusters without incurring excessive material temperatures is by the addition of heat to the supersonic stream. The present experimental work studies the possibility of heat addition due to partial condensation of lithium vapor propellant in the supersonic portion of a nozzle. The experimental apparatus consists of a re-entrant nozzle mounted at the end of a lithium heat pipe, which acts as an isothermal plenum for temperature greater than 1200 K. Nozzle area ratio was varied from 20 to 400 and nozzle half angle from 2.5 deg to 5.0 deg. The small nozzle divergence was selected in an attempt to enhance condensation effects. Stagnation temperature was varied from 1275 to 1710 K corresponding to plenum pressures of 0.05 to 2 atmospheres. From the measured thrust, mass flow rate, and plenum stagnation temperature a specific impulse can be calculated. Results show that little or no condensation occurs for the conditions which were studied and that the exhaust velocity is predicted, to good agreement, by the equations of isentropic vapor flow without condensation. Author

N72-29242# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Reaktorbauelemente.
FLOW DYNAMICS AND AEROACOUSTIC PHENOMENA IN CYLINDRICAL LATTICES
Ernst Heinecke Dec. 1971 78 p refs In GERMAN Prepared in part for Tech. Univ., Berlin (West Ger.)
(JUL-815-RB) Avail: AEC Depository Libraries

Fluid flow through a series of cylindrical lattices was studied to determine the hydrodynamic, aerodynamic, and acoustic behavior. The cylinders were arranged in a checkerboard fashion. Distances between cylinder axes were varied within a wide range. The maximum number of successive series in the flow direction was ten. For Reynolds numbers below 1000, the flow

pattern of water was studied visually. Vortex formation was caused by coupling effects on adjacent cylinders. Vortex formation was predominantly laminar. For Reynolds numbers in the range from 10,000 to 100,000 and with air flow through the cylinder lattice, the flow became increasingly turbulent. Methods for calculating the flow patterns were developed. If the eigenfrequency of the flow channel containing the cylinder was known, a boundary could be established below which the triggering of standing acoustic waves became improbable. NSA

N72-29243# Ernst-Mach-Inst., Freiburg (West Germany).
COMPUTATION AND VISUALIZATION OF THE ENTROPY WAKE BEHIND BLUNT BODIES IN HYPERSONIC FLOW [BERECHNUNG UND VISUALISIERUNG DES ENTROPIEN-ACHLAUFS STUMPFER HYPERSCHALL-FLUGKOERPER]
Hartmut Giesbrecht, Wolfgang Merzkirch, and Alois Stilp Dec. 1971 40 p refs In GERMAN; ENGLISH summary
(Rept-8/71) Avail: NTIS HC $4.00

The diameters of the entropy wakes behind spheres and cylinders launched in a free-flight range and flying in the direction of their axes were measured by means of schlieren photographs. In certain cases schlieren photographs show a dark and a bright line on each side of the flight axis, called the optical boundaries of the entropy wake, which correspond to the extremes of the schlieren system light beam deflection angles. These can be calculated from the density distribution in the wake which is obtained from a given bow shock profile. Agreement with theoretical value is satisfactory. It is found that the entropy wake grows larger both with increasing flight Mach number and drag coefficient of the model. ESRO

N72-29244# Cambridge Univ. (England). Dept. of Engineering.
BOUNDARY-LAYER SUCTION TO ELIMINATE CORNER SEPARATION IN CASCADES OF AEROFOILS
R. E. Peacock London Aeron. Res. Council 1971 26 p refs Supersedes ARC-27291 Sponsored by Rolls-Royce
(ARC-R/M-3663; ARC-27291) Avail: NTIS HC $3.50; HMSO £1.25; PHI $4.90

Results of a series of experiments are presented in which the corner separation existing at the junction between a cascade sidewall and a moderately loaded compressor blade in cascade was eliminated by means of a boundary-layer suction technique. The relationship which was investigated between suction flow required for control of the corner separation and the suction slot geometry is also reported. It was found that with careful positioning of the suction slot, bleed flows of less than 0.1 per cent of a half channel mass flow could result in elimination of the separation region. As a result, stagnation pressure profiles at the cascade trailing-edge plane became much more uniform, and the high loss core of fluid that would otherwise be shed downstream and into succeeding blade rows of a multi-row turbomachine was eliminated. Author (ESRO)

N72-29245# Cambridge Univ. (England). Dept. of Engineering.
THE MEASUREMENT OF REYNOLDS STRESSES IN LOW INTENSITY TURBULENCE FLOW
H. J. Perkins London Aeron. Res. Council. 1971 30 p refs Supersedes ARC-31748
(ARC-R/M-3668; ARC-31748) Avail: NTIS HC $3.50; HMSO £1.05; PHI $4.05

Some of the fundamentals of hot wire anemometry are reviewed. Methods, employing either the inclined single sensor or the X-probe, are described for measuring all six components of the symmetric Reynolds stress tensor in flows where both the mean secondary velocities and the rms turbulence fluctuations are less than about 5 percent of the primary velocity. Various methods are compared, and general rules established for obtaining high accuracy. Author (ESRO)

N72-29246# Manchester Univ. (England). Dept. of the Mechanics of Fluids.
TWO-DIMENSIONAL SELF-PRESERVING TURBULENT MIXING LAYERS AT DIFFERENT FREE STREAM VELOCITY RATIOS
A. J. Yule London Aeron. Res. Council 1972 39 p refs Supersedes ARC-32732
(ARC-R/M-3683; ARC-32732) Avail: NTIS HC $4.00; HMSO £1.38; PHI $5.80

Turbulence and mean velocity measurements were made in two mixing layers with free stream velocity ratios of 0:30 and 0:61. These measurements are compared with the classical free mixing layer investigation of Liepmann and Laufer. The experiments indicate changes in the intensity levels and the structure of the turbulence with changing free stream velocity ratio. Author (ESRO)

N72-29247# Cambridge Univ. (England). Dept. of Engineering.
THEORETICAL ANALYSIS OF FLUCTUATING LIFT ON THE ROTOR OF AN AXIAL TURBOMACHINE
R. E. Henderson and H. Daneshyar London Aeron. Res. Council 1972 30 p refs Supersedes ARC-42368
(ARC-R/M-3684; ARC-42368) Avail: NTIS HC $3.50; HMSO £1.10; PHI $4.30

A theoretical analysis is presented for the determination of the fluctuating lift generated by a moving blade row interacting with the potential flow disturbances of an upstream blade row. This analysis is an extension of the existing theories for an isolated airfoil moving through transverse and chordwise gusts. When the case of infinite spacing between the airfoils of the cascade is considered, the analysis gives the same results as the isolated airfoil theory. The mathematical representation of the cascade of airfoils is by a continuous distribution of vorticity on a reference blade and in the wakes of all the other blades. The effect of the bound vorticity of the neighboring blades is simulated by a vortex at their quarter chord points. This representation is suggested by the steady state cascade analysis. Using thin airfoil theory, an expression for the unsteady lift acting on a two-dimensional cascade of thin, slightly cambered airfoils moving through a sinusoidal disturbance in through flow velocity, is derived. Author (ESRO)

N72-29248# Royal Aircraft Establishment, Teddington (England). Aerodynamics Dept.
A COMPARISON BETWEEN TWO METHODS OF ANALYSIS OF OSCILLATORY PRESSURE MEASUREMENTS, ONE METHOD REQUIRING THE USE OF A TAPE RECORDER
A. W. Moore and B. L. Welsh London Aeron. Res. Council 1972 25 p refs Supersedes RAE-TR-71203; ARC-33470
(ARC-CP-1205; RAE-TR-71203; ARC-33470) Avail: NTIS HC $3.25; HMSO 45p; PHI $1.95

In one, a digital transfer function analyzer is used on-line to measure the in-phase and in-quadrature components of oscillatory pressure signals, with respect to a given reference signal. In the other method, the pressure signals are recorded on magnetic tape, then the recorded signals are analyzed on a digital computer at a later time. Pressures were produced by oscillating a model wing in a wind tunnel. Pressure transducers were mounted in the model at six chordwise stations, and the responses from the transducers were measured by both methods for a range of frequency and Mach number. A comparison of the results shows that there is no significant loss of accuracy in magnitude when the oscillatory pressure signals are recorded on magnetic tape for later analysis, and that the measurement of phase angle is accurate to within 1 deg. Author (ESRO)

N72-29249# Army Engineer District, Los Angeles, Calif.
SUPERCRITICAL FLOW IN CURVED CHANNELS: HYDRAULIC MODEL INVESTIGATION Final Report
Mar. 1972 88 p refs
(AD-740760; AEWES-1-109) Avail: NTIS CSCL 20/4

Hydraulic experiments on superelevation in curved trapezoidal channels with supercritical velocities were made to verify theoretical computations and model measurements for superelevation in curved channels. The report presents some of the problems encountered in the study and includes magnitudes

of superelevation and flow disturbances along with the development of safe design criteria. The objective was to find criteria that would minimize superelevation, surface waves, and flow oscillations around curves. GRA

N72-29250# Harry Diamond Labs., Washington, D.C.
VISCOUS VORTEX RATE SENSOR
Arthur J. Ostdiek Nov. 1971 139 p refs
(DA Proj. 1T0-61102-A-33-B)
(AD-740747; HDL-TR-1555) Avail: NTIS CSCL 13/7

The operation of a flueric vortex rate sensor is discussed for flows in the fully developed range, the range in which the entrance conditions at the periphery of the chamber do not appreciably influence the radial velocity profile throughout most of the chamber. Operation in this range is far different from that in the small boundary layer range usually considered in previous investigations. An intuitive examination shows that the frequency response and rate threshold of the sensor are inferior in the small-boundary-layer range, chosen originally for its desirable gain features. Author (GRA)

N72-29251# ARO, Inc., Arnold Air Force Station, Tenn.
VELOCITY DETERMINATION BY MEASUREMENT OF THE DOPPLER SHIFT OF A SPECTRAL LINE Final Report, Jul. 1969 - Jul. 1970
H. T. Bentley, III, V. A. Cline, and E. D. Tidwell AEDC Apr. 1972 50 p refs
(Contract F40600-72-C-0003)
(AD-740549; ARO-OMD-TR-71-103; AEDC-TR-71-175) Avail: NTIS CSCL 20/4

Measurement of gas velocity in a high enthalpy, arc-heated facility has usually been inferentially derived. The ability to measure a directly related quantity, the shift in frequency of an emitting spectral line, enables the velocity to be obtained in a noninteracting manner. The theory concerning the line shape and other inversion requirements is discussed. Three mathematical techniques for separating the lines are discussed and examples of each are given. Furthermore, the results of an Abel inversion are obtained. The test apparatus which consists of the high velocity arc source, optics, spectrometer, and either a photographic plate or electro-optical readout is described, and experimental results are presented. Author (GRA)

N72-29252# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
A STUDY OF TWO DIMENSIONAL JET ATTACHMENT ON A PLANE WALL Final Report, 1 Sep. 1969 - 28 Feb. 1972
James C. Williams, III 31 Mar. 1972 50 p refs
(Contract DAHC04-69-C-0084)
(AD-740220; AROD-8698-2-E) Avail: NTIS CSCL 20/4

A study is reported of the two-dimensional turbulent jet reattachment phenomenon. The flow field between jet exhaust and reattachment has been studied for the case where a plane wall, parallel to the nozzle axis, exists near a jet issuing from the nozzle. The two-dimensional boundary layer equations, including curvature effects, are employed in the analysis and these equations are solved using the method of weighted residuals. The model developed is used to study the location of the reattachment point, the wall pressure distributions, velocity profiles and pressure distributions for the flow field described above. Author (GRA)

N72-29253# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
AN ANALYTICAL SOLUTION OF WALL TEMPERATURE DISTRIBUTION FOR TRANSPIRATION AND LOCAL MASS INJECTION OVER A FLAT PLATE
R. Pavris and W. Tabkoff Mar. 1972 42 p refs
(Contracts DAHC04-69-C-0016; Grant DA-31-124-ARO(D)-G154)
(AD-740218; THEMIS-AE-72-25; AROD-T-4-43-E) Avail: NTIS CSCL 20/4

An analytical solution is given of the non-similar laminar boundary layer with continuous or local injection and variable wall temperature. The solution is for a flat plate with zero pressure gradient, but it can be modified for variable pressure. The method consists of transforming the partial differential equations for momentum and enthalpy and then solving the transformed equations by assuming polynomial velocity and temperature profiles. The first part presents the solution for continuous injection (transpiration cooling), and the second part involves discontinuous boundary conditions due to local injection. Author (GRA)

N72-29254# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A THEORETICAL INVESTIGATION OF SHOCK WAVES IN WATER AND WATER-POLYURETHANE MIXTURES M.S. Thesis
Richard F. Fischer Jun. 1971 103 p refs
(AD-741456; GAW/MC/71-7) Avail: NTIS CSCL 13/4

A theoretical investigation was made to predict the attentuation of compression waves resulting from impacts into water and water--polyurethane mixtures. Three point source energy release impact theories, one plane impact theory and three mixture theories were used in the investigation. Results from the point source theories were compared with experimental data for impacts into water. All of the theories overpredicted the initial pressure and none of them matched experimental data close enough to determine one superior. The overprediction of initial pressure was due primarily to the assumption that all the projectile kinetic energy is released on impact. Also, a linear Hugoniot equation for water was used that was not valid for the pressure range in which most of the experimental data was taken. Author (GRA)

N72-29255# Naval Postgraduate School, Monterey, Calif.
THE APPLICATION OF HOLOGRAPHIC INTERFEROMETRY TO THE DETERMINATION OF THE FLOW FIELD AROUND A RIGHT CIRCULAR CONE AT ANGLE OF ATTACK
Daniel J. Collins and Ravi C. Jagota Dec. 1971 157 p refs
(WR0100301)
(AD-741067; NPS-57CO71111A) Avail: NTIS CSCL 20/4

The successful application of holography to the study of three dimensional flow fields due to phase objects has been reported in the literature. The present report extends this technique to the study of density fields around opaque bodies as would normally be encountered in wind tunnel experiments. The density field around a 10 degree half-angle cone at zero and ten degree angle of attack has been investigated by means of the finite fringe holographic interferometry. The three dimensional density field obtained from the reduction of the interferograms was found to agree with that obtained from an analytical solution of the governing equations. GRA

N72-29256# Aerospace Corp., San Bernardino, Calif.
NONEQUILIBRIUM BLUNT BODY FLOW OF AIR AT LOW REYNOLDS NUMBER Final Report, Jun. 1969 - Dec. 1970
Arnold J. Galloway and Martin H. Steiger 16 Feb. 1972 129 p refs
(Contract F04701-71-C-0172)
(AD-740497; TR-0172(S2816-35)-1; SAMSO-TR-72-35) Avail: NTIS CSCL 16/3

The report treats the nonequilibrium air flow around blunt bodies at high altitudes and reentry conditions. The inverse method is employed, and a reduced form of the Navier-Stokes equations is solved by finite difference techniques. Solutions are obtained for the flow around bodies which generate spherical, parabolic, and hyperbolic shock shapes. Body shapes closely resembling spherically blunted cones are obtained. The present solutions are compared with a very limited data base and other calculations. The results are shown to agree reasonably well with the data and the independent calculations. GRA

N72-29257# Naval Postgraduate School, Monterey, Calif. Dept. of Physics.
AMPLITUDE MODULATION OF A STATIONARY ACOUSTIC FIELD BY CAVITATION BUBBLES M.S. Thesis
Walter William Scherf Dec. 1971 36 p refs
(AD-741129) Avail: NTIS CSCL 20/4

The paper concerns the effects of cavitation-induced bubbles in amplitude modulating a medium intensity (from about 0.02 bar (rms) to about 0.15 bar (rms)) standing wave field. The bubbles, after generation, are trapped at the nodes or anti-nodes of an acoustic standing wave field, and at sufficiently high driving levels dance around and act as sound scatterers. The constant generation, growth in size, dancing about and eventual escape of the trapped bubbles causes the scattered acoustic energy to modulate randomly the exciting carrier signal. The purpose of this research was to measure the frequency spectra for this random modulation signal. Author (GRA)

N72-29258# Naval Ordnance Lab., White Oak, Md.
AN EXPERIMENTAL INVESTIGATION OF MEANS TO SUPPRESS THE FLUTTER MOTION OF ELASTICALLY SUSPENDED CYLINDERS EXPOSED TO UNIFORM CROSS FLOW
J. Berezow and D. W. Sallet 28 Feb. 1972 126 p refs
(AD-741682; NOLTR-72-6) Avail: NTIS CSCL 20/4

When an elastically supported circular cylinder is brought into steady fluid flow, flutter motions occur when it is subjected to flow velocities which exceed a certain critical velocity. The flow-induced vibrations can be reduced by modifying the surface of the cylinder. This report discusses the effects of 21 surface modifications on the flow-induced vibrations. It is noted how surface modifications can reduce the amplitudes of the flutter motions. GRA

N72-29259# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TURBULENT BOUNDARY LAYER IN SUPERSONIC FLOW
Yu. V. Lapin 31 Jan. 1972 147 p refs Transl. into ENGLISH from the publ. "Turbulentnyi Pogranichnyi Sloy v Sverkhzvukovykh Potokakh Gaza" 1970 p 1-343
(AD-740212; FTD-HC-23-723-71) Avail: NTIS CSCL 20/4

The book discusses the results of theoretical and experimental studies of skin friction, heat transfer, and mass transfer in a turbulent boundary layer at supersonic gas velocities. At the same time the book presents the fundamentals of the molecular theory of gas flow. It gives derivations of the equations of turbulent flow and of boundary layer equations, in particular, for a multicomponent reacting gas. Information on the kinetics of chemical reactions in air is discussed. Problems of heat and mass transfer through permeable surfaces are also discussed. GRA

N72-29260# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN ANALYTICAL CALCULATION OF FRICTION AND HEAT TRANSFER WITH THE VISCOUS FLOW OF A COMPRESSIBLE GAS IN THE INITIAL SECTION OF A PIPE
V. T. Beloborodko, I. E. Virozub, V. F. Vishnyak, and A. S. Shvets 17 Dec. 1971 13 p refs Transl. into ENGLISH from Teplofiz. Teplotekn. (Kiev), no. 17, 1970 p 58-62
(AF Proj. AAH9)
(AD-740252; FTD-HT-23-1281-71) Avail: NTIS CSCL 20/4

A description is given of a method for solving the system of differential equations describing the development of adiabatic and nonadiabatic flows of viscous compressible gas in the initial section of a pipe. Attention is given to the case where wall surface temperature throughout the pipe is constant but not necessarily equal to the stagnation temperature at flow center. Computer calculations of flow development were performed for a number of different outlet flow velocities and wall surface temperatures. The velocity and stagnation temperature distribution along the radius are obtained for different cross sections. Graphs show the variation of boundary layer thickness along the pipe length, friction stresses, specific heat flux, and friction and heat exchange coefficients. Author (GRA)

N72-29261# Air Force Flight Test Center, Edwards AFB, Calif.
DEVELOPMENT OF AN AIR MASS FLOW CALIBRATION SYSTEM OF THE PRESSURE RISE TYPE FOR HIGH FLOW RATE AND HIGH PRESSURE Technical Report, Aug. 1968 - Aug. 1970
D. W. Young Jan. 1972 34 p refs
(AF Proj. 1426)
(AD-740433; AFFDL-TR-71-182) Avail: NTIS CSCL 14/2

Development of system for calibration of high pressure, high rate, air mass flow meters is described. Although two basically different calibration systems are being developed, only the one based on the pressure rise technique is presented in this report. Meters calibrated with these systems will be used for measuring the high pressure air flow into the arc heaters of the 2-foot and the 50-megawatt Electrogasdynamic Facilities of the Air Force Flight Dynamics Laboratory. Flow rates covered in these tests ranged from 3.2 to 8.8 pounds per second at pressures from 1000 to 2350 psi. When all systems are completed, calibration of flow rates from 0.1 to 20 pounds per second at pressures from 200 to 5000 psi will be possible. Author (GRA)

N72-29262# Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
INTERACTION OF A WALL JET WITH A SHEAR FLOW
S. Mukherji and W. Z. Sadeh Mar. 1972 86 p refs
(Contract N00014-68-A-0493-0001; NR Proj. 062-414; Proj. THEMIS)
(AD-740405; CER70-71SM-WZS82; TR-15) Avail: NTIS CSCL 20/4

An experimental investigation is reported of the flow field resulting from interaction between a spreading turbulent wall jet on a smooth surface and a shear flow. The combined flow was formed by a downward circular jet penetrating perpendicularly a moving shear stream confined within a constant-area open channel. A hot-wire survey of mean velocity and turbulence intensity was carried out. GRA

N72-29263# Army Foreign Science and Technology Center, Charlottesville, Va.
SOME CHARACTERISTICS OF JETS IN FLUIDICS ELEMENTS
I. V. Lebedev Apr. 1972 11 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energ. (Minsk), no. 10, 1968
(AD-742133; FSTC-HT-23-965-71) Avail: NTIS CSCL 13/7

The report describes theoretical and experimental research into the aerodynamics of an isoteric jet of viscous incompressible homogenous liquid propagating between two parallel walls. Author (GRA)

N72-29264# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
WAKE LABORATORY EXPERIMENT Semiannual Technical Report, 1 Sep. 1971 - 1 Apr. 1972
Gordon E. Merritt 1 Apr. 1972 33 p refs
(Contract N00014-72-C-0073; ARPA Order 1919; NR Proj. 062-454)
(AD-742092; CAL-SC-5047-A-1) Avail: NTIS CSCL 20/4

The objective of the research program is to obtain analytical and experimental data that can be used for predicting the concentration (as a function of downstream distance) of a passive tracer released into the wake of a self-propelled body travelling through a stably-stratified medium. To achieve this capability, information is required on the wake shape and size. The experimental approach utilizes a stratified flow in which local color changes are generated at a grid by electrical impulses. GRA

N72-29265# Tennessee Univ., Tullahoma. Space Inst.
PRELIMINARY REVIEW OF APPROXIMATE CALCULATIVE METHODS FOR TRANSONIC FLOW AROUND BODIES OF

REVOLUTION
Jain-Ming Wu and Kinya Aoyama Mar. 1972 34 p refs
(Contract DAAH01-71-C-1078; DA Proj. 1M2-62303-A-214)
(AD-741830; RD-TR-72-4) Avail: NTIS CSCL 20/4

The main purpose of the report is to discuss some known available transonic flow approximate treatments and their applicabilities, including their limitations. This may suggest the possible future improvement of efforts in this renewed field.
Author (GRA)

N72-29266# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
PERIODIC COMPRESSIBLE NOZZLE FLOW CAUSED BY HEAT ADDITION DUE TO CONDENSATION
Dominic J. Cagliostro and Peter P. Wegener Feb. 1972 107 p refs
(Grant AF-AFOSR-1937-70; AF Proj. 9711)
(AD-741884; AFOSR-72-0627TR) Avail: NTIS CSCL 20/4

Periodic, unsteady, compressible nozzle flow caused by heat addition due to condensation in the transonic region is investigated. The experiments were performed in an intermittent tube wind-tunnel. Flow with varying expansion rates, relative and specific humidities, pressures, and temperatures was studied. Measurements were made by pressure and temperature recordings, streak interferograms and high-speed shadowgraph movies. A dimensional analysis that relates the frequency of the cyclic flow to the supply conditions and cooling rate was performed, and correlated with the measurements. Based on a linear approximation, possible solutions of the equations of motion for steady, transonic, diabatic, inviscid flow in the throat region of a nozzle are discussed. GRA

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N72-29267*# Texas Technological Univ., Lubbock.
DYNAMICS OF PLAYA LAKES IN THE TEXAS HIGH PLAINS
C. C. Reeves, Principal Investigator 30 Jul. 1972 2 p Sponsored by NASA
(E72-10015; NASA-CR-127494) Avail: NTIS HC $3.00 CSCL 08H

There are no author-identified significant results in this report.

N72-29268*# Corps of Engineers, Waltham, Mass. New England Div.
ERTS-A DATA USER INVESTIGATION OF THE USE OF ERTS IMAGERY IN RESERVOIR MANAGEMENT AND OPERATION Progress Report, 14 Jun. - 14 Aug. 1972
Saul Cooper, Co-Principal Investigator and Paul Bock, Co-Principal Investigator 11 Aug. 1972 5 p Sponsored by NASA
(E72-10016; NASA-CR-127495) Avail: NTIS HC $3.00 CSCL 08H

There are no author-identified significant results in this report.

N72-29269*# Natural Resources Management Corp., Berkeley, Calif. Research and Development Div.
INVESTIGATION OF THE DETECTION AND MONITORING OF FOREST INSECT INFESTATIONS IN THE SIERRA NEVADA MOUNTAINS OF CALIFORNIA Progress Report, Jun. - Jul. 1972
Ralph C. Hall, Principal Investigator Jul. 1972 6 p
(Contract NAS5-21770)
(E72-10017; NASA-CR-127496; NRM-A) Avail: NTIS HC $3.00 CSCL 02F

There are no author-identified significant results in this report.

N72-29270*# Vermont Univ., Burlington.
ENVIRONMENTAL STUDY OF ERTS-A IMAGERY LAKE CHAMPLAIN BASIN AND VERMONT Bimonthly Report, 8 Jun. - 1 Aug. 1972
A. O. Lind, Principal Investigator 1 Aug. 1972 2 p
(Contract NAS5-21753)
(E72-10018; NASA-CR-127742; GSFC-ID-UN137) Avail: NTIS HC $3.00 CSCL 08H

There are no author-identified significant results in this report.

N72-29271*# Earth Satellite Corp., Washington, D.C.
INVESTIGATION TO IMPROVE MENHADEN FISHERY PREDICTION Progress Report, 1 Jun. - 31 Jul. 1972
Paul M. Maughan, Principal Investigator 7 Aug. 1972 2 p
(Contract NAS5-21743)
(E72-10019; NASA-CR-127743; ERTS-I/2) Avail: NTIS HC $3.00 CSCL 08A

There are no author-identified significant results in this report.

N72-29272*# New York State Univ., Albany.
TO EVALUATE ERTS-A DATA FOR USEFULNESS AS GEOLOGICAL SENSOR Progress Report, period ending 31 Jul. 1972
Y. W. Isachsen, Principal Investigator 31 Jul. 1972 2 p Sponsored by NASA
(E72-10020; NASA-CR-127744) Avail: NTIS HC $3.00 CSCL 08G

There are no author-identified significant results in this report.

N72-29273*# State of Ohio Dept. of Development, Columbus.
RELEVANCE OF ERTS TO THE STATE OF OHIO Progress Report, Jul. 1972
David C. Sweet, Principal Investigator Jul. 1972 3 p Prepared in part by Battelle Mem. Inst., Columbus, Ohio
(Contracts NAS5-21782; BCL-72-17/G-1793)
(E72-10021; NASA-CR-127745) Avail: NTIS HC $3.00 CSCL 08G

There are no author-identified significant results in this report.

N72-29274*# Nebraska Univ., Lincoln.
MAPPING AND MANAGING SOIL AND RANGE RESOURCES IN THE SAND HILLS REGION OF NEBRASKA Progress Report, 1 Jun. - 31 Aug. 1972
James V. Drew, Principal Investigator 31 Aug. 1972 3 p
(Contract NAS5-21756)
(E72-10022; NASA-CR-127746) Avail: NTIS HC $3.00 CSCL 08G

There are no author-identified significant results in this report.

N72-29275*# National Environmental Satellite Service, Washington, D.C.
EVALUATION OF ERTS DATA FOR CERTAIN OCEANOGRAPHIC USES Progress Report, Apr. - Jul. 1972
Alan E. Strong, Principal Investigator 2 Aug. 1972 2 p
(NASA Order S-70246-AG)
(E72-10023; NASA-CR-127747; BMPR-1) Avail: NTIS HC $3.00 CSCL 08J

There are no author-identified significant results in this report.

N72-29276*# Illinois Univ., Urbana. Aeronomy Lab.
AN INVESTIGATION OF THE IONOSPHERIC D REGION AT SUNRISE
R. P. Turco and C. F. Sechrist, Jr. 1 Dec. 1970 194 p refs
(Grants NGR-14-005-013; NSF GA-14232)
(NASA-CR-127785; UILU-Eng-70-264; Aeronomy-41) Avail: NTIS HC $11.75 CSCL 03B

The growth over sunrise of the C and D layers of the ionosphere is investigated. The model which is analyzed includes the negative ion species O(-), O2(-), O3(-), O4(-), NO3(-), CO3(-), and CO4(-). Ionization sources due to galactic cosmic rays,

precipitated electrons, ionization of NO by scattered Lyman alpha radiation, and the direct solar radiation ionization are also included. The photodetachment of most of the negative ions is discussed, as well as the time variation of these parameters. The time variations of the electron, negative ion, and positive ion densities are calculated over sunrise. From these data, the mesospheric C and D layer development is plotted. Several model parameters are varied until the best agreement with experimentally determined electron densities is obtained. The results are discussed in light of several atmospheric parameters including the O and NO concentrations and the electron-ion recombination coefficient. Author

N72-29277*# TRW Systems Group, Redondo Beach, Calif. Space Sciences Dept.
ELECTROSTATIC INSTABILITY OF RING CURRENT PROTONS BEYOND THE PLASMAPAUSE DURING INJECTION EVENTS
F. V. Coroniti (Calif. Univ., Los Angeles), R. W. Fredricks, and Roscoe White (Calif. Univ., Los Angeles) 1 May 1972 12 p refs
(Contracts NASw-2357)
(NASA-CR-127756; TRW-22935-6001-R0-00) Avail: NTIS HC $3.00 CSCL 04A

The stability of ring current protons with an injection spectrum modeled by an m = 2 mirror distribution function was examined for typical ring current parameters. It was found that the high frequency loss cone mode can be excited at wave numbers K lambda sub Di about = 0.1 to 0.5, at frequencies omega about = (0.2 to 0.6) omega sub pi and with growth rates up to gamma/omega sub pi about = 0.03. These waves interact with the main body of proton distribution, and propagate nearly perpendicular to the local magnetic field. Cold particle partial densities tend to reduce the growth rate so that the waves are quenched at or near the plasmapause boundary. Wave e-folding lengths are comparable to 0.1 R sub e, compared to the value of about 4 R sub e found for ion cyclotron waves at the same plasma conditions. Author

N72-29278*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
LIGHTNING SUMMARY REPORT THROUGH 1971
18 Feb. 1972 50 p refs Revised
(NASA-TM-X-68398; KSC-TR-942) Avail: NTIS HC $4.50 CSCL 04A

An updated summary is presented of the lightning activity recorded at the John F. Kennedy Space Center and the Cape Kennedy Air Force Station. Data was compiled during the periods 1903 through 1924, 1957 through 1962, and 1964 through 1971. Author

N72-29279*# Grambling Coll., La. Dept. of Physics.
FREQUENCY DEPENDENCE OF ATS-1 OBSERVED MICROPULSATIONS ON SOME GEOPHYSICAL PARAMETERS Semiannual Status Report
W. D. Cummings, Freddie Mason, and P. J. Coleman, Jr. (Calif. Univ., Los Angeles) 8 Jun. 1972 21 p Presented at 53d Ann. Meeting of the Am. Geophys. Union, 19 Apr. 1972
(Grants NGR-19-011-007; NGL-05-007-004)
(NASA-CR-127801) Avail: NTIS HC $3.25 CSCL 03B

Low frequency oscillations in the earth's magnetic field at the synchronous orbit were observed with the magnetometer experiment on board the ATS-1 satellite since Dec. 1966. It was found that the frequency of an event increases with the sum of Kp for 24 hours prior to the event midpoint. For events with duration greater than 6 hours, the product moment correlation coefficient for frequency, f, and Kp was R = 0.87. For the same events the correlation coefficient for frequency and Dst was R = -0.83. Author

N72-29280*# Stanford Univ., Calif. Radioscience Lab.
VHF/UHF TECHNIQUE FOR THE DETERMINATION OF THE COLUMNAR ELECTRON CONTENTS OF THE PLASMASPHERE AND OF THE PROTONOSPHERE USING GEOSTATIONARY SATELLITE TRANSMISSION: OBSERVATIONS DURING MAGNETIC STORMS
Odmar Geraldo Almeida May 1972 101 p refs
(Grant NGR-05-020-001)
(NASA-CR-127804; TR-14; SU-SEL-72-019) Avail: NTIS HC $7.25 CSCL 03B

Measurements of the total electron content of the plasmasphere up to geostationary heights were made using the beacon transmitters aboard the satellite ATS-3. The technique employed is a combination of the phase-path length difference and the Faraday rotation angle methods. Such a combination permits very accurate determination of the integration constant necessary to convert phase-path length difference data into information about the absolute value of the columnar content. Author

N72-29281*# Stanford Univ., Calif. Radioscience Lab.
THE COUPLING BETWEEN THE IONOSPHERE AND THE PROTONOSPHERE AND ITS IMPLICATIONS ON THE LONG TERM VARIATIONS OF IONOSPHERIC ELECTRON CONTENT
Helio Waldman Sep. 1971 188 p refs
(Grant NGR-05-020-001)
(NASA-CR-127805; TR-13; SU-SEL-71-048) Avail: NTIS HC $11.50 CSCL 03B

The long-term variations in the daytime exchange flux are estimated with the use of model hydrogen concentrations based on the inverse relationship between the abundance of neutral hydrogen and the neutral temperature in the thermosphere. The results are found to be compatible with the observed long-term behavior of the ionospheric electron content at a midlatitude location, as revealed by Faraday observations using geostationary satellites. The basic processes occurring in the ionosphere are reviewed, with emphasis on the concepts of limiting velocity and limiting flux. An approach to the problem of numerical simulation of the ionosphere is also presented and discussed. Author

N72-29282*# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
ANALYSIS OF AURORAL PARTICLE FLUXES Final Report
C. R. Chappell 1 Jun. 1972 63 p refs
(Contracts NASw-2212; NSR-44-006-004)
(NASA-CR-127783) Avail: NTIS HC $5.25 CSCL 04A

The physical processes which describe the interaction of auroral electrons with the atmosphere appear to be more complex than just the Coulomb scattering of the incident primary electrons with a subsequent loss of energy. The comparison of the measured backscattered electron spectra with spectra predicted using a theoretical scattering calculation has led to a discrepancy for energies below about 1 to 2 keV. It was found that the very high ratio (100%) of backscattered to incident fluxes for these energies could be most reasonably explained by a parallel downward-directed electric field which prevents these lower energy electrons from entering the atmospheric scattering region. This parallel field with potential drop of about 1 keV is thought to have its origin in waveparticle interactions in the turbulent auroral ionosphere. Author

N72-29283# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
REPORTS RELATIVE TO CARTOGRAPHY AND SERVEYING. SERIES 1: GERMAN CONTRIBUTIONS AND INFORMATION, NO. 53 [NACHRICHTEN AUS DEM KARTEN- UND VERMESSUNGSWESEN. REIHE 1: DEUTSCHE BEITRAEGE UND INFORMATIONEN]
1971 156 p refs In GERMAN
Avail: NTIS HC $10.25

The development of new procedures for numerical photogrammetry is discussed. The application of computer programs for improved photogrammetry and cartography is explained. Examples of lectures and demonstrations of related computer programming are included. The significance of these

new developments for cadastral survey and boundary determination is emphasized. For individual titles, see N72-29284 through N72-29291.

N72-29284 Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
INCREASED EFFICIENCY IN NUMERICAL PHOTOGRAMMETRY [LEISTUNGSSTEIGERUNG IN DER NUMERISCHEN PHOTOGRAMMETRIE] **c14**
F. Ackermann *In its* Rept. Relative to Cartography and Surveying, No. 53 1971 p 9-35 refs In GERMAN (For availability see N72-29283 20-13)

The development and application of numerical photogrammetry based on aerial photography are discussed. The advantages and limitations of numerical photogrammetry are presented. The application of computer programs for increased accuracy of mapping and geodetic surveying is explained. The characteristics of instruments for aerial triangulation are described. Transl. by P.N.F.

N72-29285 Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THE PROGRAM PACKAGE PAT-M FOR THREE DIMENSIONAL AEROTRIANGULATION WITH INDEPENDENT MODELS [DAS PROGRAMM-PAKET PAT-M FUER DIE RAEUMLICHE AEROTRIANGULATION MIT UNABHAENGIGEN MODELLEN]
H. Ebner *In its* Rept. Relative to Carography and Surveying, No. 53 1971 p 37-50 refs In GERMAN (For availability see N72-29283 20-13)

A computer program for three dimensional aerial triangulation is presented. The application of the procedure for point measurements in order to establish a basis for geodetic surveys is described. The principle of compensation as used with photogrammetry is examined. The use of independent models for determining coordinates and the accuracy which may be expected are reported. Transl. by P.N.F.

N72-29286 Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
PRECISION PROBABILITIES OF PHOTOGRAMMETRIC BLOCKS WITH LARGE POINT MASSES [GENAUIGKEITSERWARTUNGEN PHOTOGRAMMETRISCHER BLUECKE MIT GROSSEN PUNKTMENGEN] **c14**
H. Ebner *In its* Rept. Relative to Cartography and Surveying, No. 53 1971 p 51-71 refs In GERMAN (For availability see N72-29283 20-13)

The importance of precise models for the planning of photogrammetry projects is described. The use of photogrammetry for point determination by block triangulation is discussed. The accuracy of block triangulation using the method of independent models is examined. Examples of computer programs applied to improved accuracy of photogrammetry are included.
Transl. by P.N.F.

N72-29287 Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
BLOCK ADJUSTMENT IN THE CADASTRE AND IN FIELD MAPPING [BLOCKAUSGLEICHUNGEN IM KATASTER UND IN DER FLURBEREINIGUNG]
Karl Kraus *In its* Rept. Relative to Cartography and Surveying, No. 53 1971 p 73-97 refs In GERMAN (For availability see N72-29283 20-13)

Photogrammetry as a method for point determination to replace standard surveying instruments and practices is discussed. Photogrammetry is employed under the following conditions: (1) availability of good aerial visibility, (2) large areas with many points which are to be measured, and (3) the additional location of topographical details of a certain surrounding area are desired. Various hypotheses on the application of photogrammetry to surveying and mapping are presented. Mathematical models are included to support the theoretical considerations.
Transl. by P.N.F.

N72-29288 Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
COMBINED PHOTOGRAMMETRIC-TERRESTRIAL CADASTRAL SURVEY [KOMBINIERTE PHOTOGRAMMETRISCH-TERRESTRISCHE KATASTERVERMESSUNG]
In its Rept. Relative to Cartography and Surveying, No. 53 1971 p 99-122 refs In GERMAN (For availability see N72-29283 20-13)

The capabilities of photogrammetry, with emphasis on the integration of the coordinates of terrestrial landmarks, are discussed. A program for obtaining photogrammetric coverage of selected areas of Germany is presented. The use of photogrammetry to refine the measurements of areas which have been previously mapped is explained. Transl. by P.N.F.

N72-29289 Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THE APPLICATION OF THE INTEGRATED PHOTOGRAMMETRIC DATA PROCESS IN FIELD MAPPING [DIE ANWENDUNG DER INTEGRIERTEN PHOTOGRAMMETRISCHEN DATENVERARBEITUNG IN DER FLURBEREINIGUNG]
K. Heiland *In its* Rept. Relative to Cartography and Surveying, No. 53 1971 p 123-134 refs In GERMAN (For availability see N72-29283 20-13)

The practical application of photogrammetry to measure the roadways and waterways of the Baden-Wurttemburg area of Germany is discussed. The techniques for establishing ground reference points and boundaries are explained. The accuracy obtained by the proposed methods is described. Graphs are included to compare the results obtained from various methods of coordinate determination. Transl. by P.N.F.

N72-29290 Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
COMPUTER CENTERS FOR PHOTOGRAMMETRY [GROSSRECHENANLAGEN IN DER PHOTOGRAMMETRIE]
H. Klein *In its* Rept. Relative to Cartography and Surveying, No. 53 1971 p 135-145 In GERMAN (For availability see N72-29283 20-13)

The application of data processing equipment for analyzing the voluminous amounts of photogrammetric data acquired during surveys of German areas is described. The characteristics of various computers are presented to show the respective advantages and disadvantages for processing photogrammetric data. The computer program of greatest value is written in FORTRAN and tested on ASA-Standard. The program can be used on all computer installations which have a FORTRAN compiler. Transl. by P.F.N.

N72-29291 Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
DISCUSSION OF POSSIBILITIES AND CONDITIONS FOR THE PRACTICAL APPLICATION IN PHOTOGRAMMETRIC CADASTRAL SURVEYING [DISKUSSION DER MOEGLICHKEITEN UND BEDINGUNGEN FUER DIE PRAKTISCHE ANWENDUNG DER PHOTOGRAMMETRISCHEN KATASTERVERMESSUNG]
F. Ackermann *In its* Rept. Relative to Cartography and Surveying, No. 53 1971 p 147-160 In GERMAN (For availability see N72-29283 20-13)

The conditions for the practical application of photogrammetry are examined. The factors which influence the accuracy of numerical photogrammetry are explained. The use of computer programs and services to process the data is described. Methods for improving the accuracy of photogrammetric data are analyzed. Transl. by P.F.N.

N72-29292*# California Univ., Los Angeles. Dept. of Physics.
LOCATING THE MAGNETOSPHERIC RING CURRENT
Richard M. Thorne and C. F. Kennel Mar. 1971 12 p refs (Grant NGL-05-007-190; Contracts N00014-69-A-0200-4023;

AT(04-3)-34; Grant NSF GP-22817)
(NASA-CR-127769; R-88) Avail: NTIS HC $3.00 CSCL 03B

Protons are studied in the global depression of the earth's horizontal magnetic field. It is shown that 10 to 100 keV protons dominate ring current energetics in two preferred regions of cyclotron instability, which serve as stable trapping boundaries for ring current protons. The only apparent means of removing this stably trapped belt of particles are considered to be by charge exchange interactions, or by outward expansion of the plasmapause to erode the ring current. Both of these processes require about two days, which is the characteristic decay period of the main phase depression. Questions whose answers are necessary to formulate a quantitative theory of geomagnetic storms which relates main phase depression to solar wind parameters are included. F.O.S.

N72-29293*# Boeing Co., Seattle, Wash. Computer Services.
NATURAL RESOURCE INFORMATION SYSTEM, REMOTE SENSING STUDIES Final Report
J. Leachtenauer, R. Hirsch, V. Williams, and R. Tucker May 1972 116 p Sponsored by Bur. of Indian Affairs, Earth Resources Observation Systems program, and NASA
(NASA-CR-127809; USGS-DO-72-015) Avail: NTIS HC $8.00 CSCL 02F

Potential applications of remote sensing data were reviewed, and available imagery was interpreted to provide input to a demonstration data base. A literature review was conducted to determine the types and qualities of imagery required to satisfy identified data needs. Ektachrome imagery available over the demonstration areas was reviewed to establish the feasibility of interpreting cultural features, range condition, and timber type. Using the same imagery, a land use map was prepared for the demonstration area. The feasibility of identifying commercial timber areas using a density slicing technique was tested on multispectral imagery available for a portion of the demonstration area. Author

N72-29294*# Boeing Co., Seattle, Wash. Computer Services.
NATURAL RESOURCE INFORMATION SYSTEM, DESIGN ANALYSIS Final Report
May 1972 31 p refs Sponsored by Bur. of Indian Affairs, Earth Resources Observation Systems program, and NASA
(NASA-CR-127810; USGS-DO-72-014) Avail: NTIS HC $3.75 CSCL 08G

The computer-based system stores, processes, and displays map data relating to natural resources. The system was designed on the basis of requirements established in a user survey and an analysis of decision flow. The design analysis effort is described, and the rationale behind major design decisions, including map processing, cell vs. polygon, choice of classification systems, mapping accuracy, system hardware, and software language is summarized. Author

N72-29295*# Boeing Co., Seattle, Wash. Computer Services.
NATURAL RESOURCE INFORMATION SYSTEM. VOLUME 1: OVERALL DESCRIPTION
Apr. 1972 58 p refs Sponsored jointly by NASA, Bur. of Indian Affairs, and Earth Resources Observation Systems program Prepared for Bur. of Indian Affairs and Bur. of Land Management, Dept. of Interior
(Contract K51C14200459)
(NASA-CR-127812; USGS-DO-72-012-Vol-1) Avail: NTIS HC $5.00 CSCL 08G

A prototype computer-based Natural Resource Information System was designed which could store, process, and display data of maximum usefulness to land management decision making. The system includes graphic input and display, the use of remote sensing as a data source, and it is useful at multiple management levels. A survey established current decision making processes and functions, information requirements, and data collection and processing procedures. The applications of remote sensing data and processing requirements were established. Processing software was constructed and a data base established using high-altitude imagery and map coverage of selected areas of SE Arizona. Finally a demonstration of system processing functions was conducted utilizing material from the data base. Author

N72-29296*# Boeing Co., Seattle, Wash. Computer Services.
NATURAL RESOURCE INFORMATION SYSTEM. VOLUME 2: SYSTEM OPERATING PROCEDURES AND INSTRUCTIONS Final Report
Apr. 1972 57 p refs Sponsored by NASA, Bur. of Indian Affairs, Earth Resources Observation Systems program Prepared for Bur. of Indian Affairs and Bur. of Land Management, Dept. of Interior
(NASA-CR-127811; USGS-DO-72-013-Vol-2) Avail: NTIS HC $5.00 CSCL 08G

A total computer software system description is provided for the prototype Natural Resource Information System designed to store, process, and display data of maximum usefulness to land management decision making. Program modules are described, as are the computer file design, file updating methods, digitizing process, and paper tape conversion to magnetic tape. Operating instructions for the system, data output, printed output, and graphic output are also discussed. Author

N72-29297# Department of Energy, Mines and Resources, Ottawa (Ontario).
RECOMMENDED NATIONAL PROGRAM FOR REMOTE SENSING
[1972] 14 p
Avail: NTIS HC $3.00

The recommended program for remote sensing is presented. The elements of the program discussed include: ground readout station, ground data handling centers, air photo library, remote sensing program, international cooperation, and Canadian resource satellite development. F.O.S.

N72-29298# Toronto Univ. (Ontario). Inst. of Environmental Sciences and Engineering.
REMOTE SENSING EVALUATION OF ENVIRONMENTAL FACTORS AFFECTING THE DEVELOPMENTAL CAPACITY OF INLAND LAKES
S. J. Glenn Bird 9 Feb. 1972 20 p ref Presented at 1st Can. Remote Sensing Symp., Ottawa, 9 Feb. 1972
(Rept-1001180) Avail: NTIS HC $3.00

Multidisciplinary aspects of remote sensing were applied to the developmental capacity of the inland lakes of Ontario. The relationship of aerial photointerpretation and remote sensing techniques to the environment evaluation is discussed. The parameters affecting the recreational land usage were evaulated, including basin physiography, water physical variables, water biological variables, and water chemical variables. J.A.M.

N72-29299# Barringer Research Ltd., Rexdale (Ontario).
EXPERIMENTAL RESULTS IN THE REMOTE SENSING OF GASES FROM HIGH ALTITUDES
A. R. Barringer and J. H. Davies [1972] 32 p
(Rept-1001244) Avail: NTIS HC $3.75

A brief history of correlation spectroscopy is provided. The continuing progress made in the experimental and theoretical development of techniques for remote sensing of trace gases by optical correlation methods is reviewed. The concept of correlation spectrometry has been improved by the use of computer techniques for correlation mask optimization, and the problems of atmospheric scattering have been investigated in some detail. Good results have been obtained in terms of monitoring patterns of pollution and tracking plumes, and methods are being developed for improving the absolute accuracy of measurements. Prospects are reviewed for the ultimate development of scanning multigas monitors for satellite platforms and their potential role in measuring the buildup of atmospheric pollution on a worldwide scale. Experiments are also described which relate to the feasibility of remote gas detection in trace amounts as an aid to natural resources exploration and survey. Author

N72-29300# McGill Univ., Montreal (Quebec). Arctic Meteorology Research Group.
EVALUATION OF NORTH WATER SPRING ICE COVER FROM SATELLITE PHOTOGRAPHS
P. G. Aber and E. Vowinckel Jun. 1971 25 p refs
(Contract DRBC-9511-107)
(Publ-101) Avail: NTIS HC $3.25

Satellite photographs for two years (March - September) have been used to study ice cover in the polynya called North Water in Canada, and to determine whether reliable ice maps can be made from satellite data without computer analysis. After early July the clouds become opaque and distinction between cloud and ice was impossible. It was concluded that ice distribution for short periods can best be obtained by careful human photointerpretation. The most persistent open water is found at the northern edge, at about 78 N. The southern ice edge is diffuse. Author

N72-29301# Aerospace Engineering Test Establishment, Ottawa (Ontario).
CF-100 HIGH ALTITUDE REMOTE SENSING PROJECT Earth Resources CF-100 Handbook
[1972] 58 p Compiled and amended monthly by AETE Uplands (Report-1000149) Avail: NTIS HC $5.00

Photographic products from CF-100 high altitude remote sensing flights are presented and the potential of small angle imagery for mapping and natural resources application is considered. The aircraft operates at a 40,000 feet ceiling for about 2.5 hrs and carries multispectral cameras. G.G.

N72-29302*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FOURTH ANNUAL EARTH RESOURCES PROGRAM REVIEW. VOLUME 1: NATIONAL AERONAUTICS AND SPACE ADMINISTRATION PROGRAMS
21 Jan. 1972 509 p refs Rev. held at Houston, Tex., 17-21 Jan. 1972 Original contains color illustrations
(NASA-TM-X-68564; MSC-05937-Vol-1) Avail: NTIS HC $27.50 CSCL 08G

Various aspects of the Earth Resources Program are reviewed with particular emphasis placed on the results of analysis of data obtained with the Manned Spacecraft Center and other aircraft which have contributed to the program. Volume 1 covers NASA programs in the disciplinary areas of geology, geography, hydrology, agriculture, forestry, and oceanography. For individual titles, see N72-29303 through N72-29326.

N72-29303* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AMES RESEARCH CENTER SR&T PROGRAM AND EARTH OBSERVATIONS
I. G. Poppoff *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 35 p (For availability see N72-29302 20-13)
CSCL 08H

An overview is presented of the research activities in earth observations at Ames Research Center. Most of the tasks involve the use of research aircraft platforms. The program is also directed toward the use of the Illiac 4 computer for statistical analysis. Most tasks are weighted toward Pacific coast and Pacific basin problems with emphasis on water applications, air applications, animal migration studies, and geophysics. A.L.

N72-29304* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DEVELOPMENT OF EARTH RESOURCES SURVEY TECHNIQUES AT GSFC: OVERVIEW
W. Nordberg *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 2 p (For availability see N72-29302 20-13)
CSCL 08G

Earth resources survey and remote sensing techniques under development at GSFC are reviewed. Emphasis is focussed primarily on: (1) definition and demonstration of remote sensing techniques which lead to the measurements of physical quantities from which earth resources related parameters can be determined; (2) development of sensors, spacecraft, and on-board as well as ground based data management systems; (3) determination of earth resources related parameters from the remote sensing observations and measurements; and (4) applications of earth observations to resource management. A.L.

N72-29305* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADIOMETRIC IMAGES ON IR RESTSTRAHLEN EMISSION FROM ROCK SURFACES **c23**
Warren A. Hovis *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 13 p ref Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 08G

In order to test the feasibility of remote sensing of the reststrahlen effect, a two-channel radiometer was constructed that sensed radiance in two channels simultaneously. The channels selected were 8.3 to 9.3 and 10.2 to 11.2 micrometers. The instrument had an instantaneous geometric field of view of 2 deg x 2 deg and a rotating mirror scan mechanism designed to produce contiguous scans from a DC-3 aircraft at approximately 10,000 ft. altitude. Signals were recorded on a magnetic tape recorder and subsequently converted to equivalent black body temperature for both channels. Results of measurements made over a number of rock types in the Maryland-Pennsylvania region are briefly discussed. A.L.

N72-29306* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NIMBUS HYDROLOGICAL OBSERVATIONS OVER THE WATERSHEDS OF THE NIGER AND INDUS RIVERS
Vincent V. Salomonson and Norman H. MacLeod *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 11 p Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 08H

As a result of studying the Nimbus imagery over these two watersheds, it is felt that a perspective and understanding of the large scale hydrological processes and their interrelationship has been obtained which could be obtained by no other means in so short a time. In the case of the Niger River a much better appreciation of the flooding process has been obtained along with the role of the Inland Delta in this process. Obviously a knowledge of the spatial and temporal distribution of the snow-melt process in the Indus River watershed is now available that was obtained with minimal effort, as compared to the effort and time that would be required using conventional methods. It seems clear that even the low resolution data easily available from meteorological satellites can be a valuable source of information in the better management of the water resources in these regions. Author

N72-29307* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPECTRAL REFLECTANCE MEASUREMENTS OF PLANT SOIL COMBINATIONS
N. H. MacLeod *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 11 p (For availability see N72-29302 20-13)
CSCL 02C

Field and laboratory observations of plant and soil reflectance spectra were made to develop an understanding of the reflectance of solar energy by plants and soils. A related objective is the isolation of factors contributing to the image formed by multispectral scanners and return beam vidicons carried by ERTS or film-filter combinations used in the field or on aircraft. A set of objective criteria are to be developed for identifying plant and soil types and their changing condition through the seasons for application of space imagery to resource

management. This is because the global scale of earth observations satellites requires objective rather than subjective techniques, particularly where ground truth is either not available or too costly to acquire. As the acquiring of ground truth for training sets may be impractical in many cases, attempts have been made to identify objectively standard responses which could be used for image interpretation. Author

N72-29308* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANALYSIS OF MULTISPECTRAL IMAGES SIMULATING ERTS OBSERVATIONS c14
Nicholas M. Short and Norman H. MacLeod *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 28 p Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 14E

Simulation studies of selected aircraft and spacecraft acquired images were initiated in response to anticipated desires of the user community for simulated imagery prior to launch of ERTS-A. Principal modes of simulation included: (1) areas of coverage comparable to ERTS; (2) spatial resolutions within these images similar to ERTS; (3) spectral responses analogous to that expected from each channel on both the return beam vidicon and multispectral scanner, leading to production of photographic images that should appear similar to those representing each band in the two sensors; and (4) runthroughs of several analytical techniques, such as color density slicing, color additive viewing, and computer-generated reflectance and surface temperature maps, by which ERTS data can be analyzed, interpreted, and applied. The two areas involved in the simulation study were Wyoming and the Chesapeake Bay region. A.L.

N72-29309* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MICROWAVE EMISSION MEASUREMENTS OF SEA SURFACE ROUGHNESS, SOIL MOISTURE, AND SEA ICE STRUCTURE c14
P. Gloersen, T. Wilheit, and T. Schmugge *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 19 p refs Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 14B

In order to demonstrate the feasibility of the microwave radiometers to be carried aboard the Nimbus 5 and 6 satellites and proposed for one of the earth observatory satellites, remote measurements of microwave radiation at wavelengths ranging from 0.8 to 21 cm have been made of a variety of the earth's surfaces from the NASA CV-990 A/C. Brightness temperatures of sea water surfaces of varying roughness, of terrain with varying soil moisture, and of sea ice of varying structure were observed. In each case, around truth information was available for correlation with the microwave brightness temperature. The utility of passive microwave radiometry in determining ocean surface wind speeds, at least for values higher than 7 meters/second has been demonstrated. In addition, it was shown that radiometric signatures can be used to determine soil moisture in unvegetated terrain to within five percentage points by weight. Finally, it was demonstrated that first year thick, multi-year, and first year thin sea ice can be distinguished by observing their differing microwave emissivities at various wavelengths. Author

N72-29310* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADIOMETRIC OCEAN COLOR SURVEYS THROUGH A SCATTERING ATMOSPHERE
Robert J. Curran and Warren A. Hovis *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 12 p refs (For availability see N72-29302 20-13)
CSCL 08J

A series of aircraft flights has been initiated to measure the spectral reflectance of ocean waters containing various concentrations of chlorophyll. The results of both the theoretical and experimental investigations indicate that satellite-borne radiometers can sense ocean color. However, the accuracy to which the chlorophyll concentration can be measured appears to be 0.1 to 0.4 mg/cu m depending upon solar zenith angles. These accuracies are less than desired by many of the oceanographers and an effort is being made to improve the quality of the chlorophyll concentration determination. Further measurements will be made in areas with higher chlorophyll concentration in order to better understand the relationship between chlorophyll concentration and ocean color. Also the effects of high water turbidity will be investigated. A.L.

N72-29311* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A MULTISPECTRAL METHOD OF MEASURING SEA SURFACE TEMPERATURES FROM SATELLITES
William E. Shenk and Vincent V. Salomonson *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 14 p refs (For availability see N72-29302 20-13)
CSCL 08J

A multispectral technique has been developed which independently tests for the presence of clouds before a registered window radiance measurement is accepted as coming from the sea surface and the intervening atmosphere. The spatial resolution of ocean temperature mapping can be the same as that of the radiometer. With the 55 km subsatellite track resolution of the Nimbus 2 MRIR, current boundaries and upwelling areas have been successfully identified. Knowledge of the position of these regions and temperatures within them are important to the detection of areas of high chlorophyll concentrations. Author

N72-29312* National Aeronautics and Space Administration. Mississippi Test Facility, Bay Saint Louis.
A SUMMARY OF ACTIVITIES OF THE EARTH RESOURCES LABORATORY AT THE MISSISSIPPI TEST FACILITY DURING 1971 c11
Robert O. Piland *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 19 p (For availability see N72-29302 20-13)
CSCL 14B

First year activities at the NASA Earth Resources Laboratory are reviewed. Covered are: (1) personnel; (2) organization; (3) technical equipment capabilities; (4) University programs; (5) agency relationships; (6) minor projects; (7) technical program; and (8) 1971 reports and products. A.L.

N72-29313* National Aeronautics and Space Administration. Mississippi Test Facility, Bay Saint Louis.
SUMMARY OF 1971 WATER REMOTE SENSING INVESTIGATIONS
Edward Lee Tilton, III *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 12 p (For availability see N72-29302 20-13)
CSCL 08J

The Earth Resources Laboratory sea remote sensing program has concentrated on project planning, data acquisition procedures, and data preparation techniques to establish a firm procedural basis for the program. Most of these procedural elements were established and proven during the three missions conducted in 1971. It is anticipated that the program in 1972 will see the analysis completed on the Mississippi Sound series and the first series of Eastern Gulf experiments allowing increased emphasis to be given to more intensive technique development studies, the interrelationship of parameters for the measurement and prediction of water circulation, and the demonstration of the application of these techniques. Author

N72-29314* National Aeronautics and Space Administration. Mississippi Test Facility, Bay Saint Louis.
MISSISSIPPI SOUND REMOTE SENSING STUDY
B. Houston Atwell and G. C. Thomann *In its* 4th Ann.

Resources Program Rev., Vol. 1 21 Jan. 1972 28 p (For availability see N72-29302 20-13)
CSCL 08J

Remote sensing techniques are being developed to study near shore marine waters in the Mississippi Sound. Specific elements of the investigation include: (1) evaluation of existing techniques and instrument capabilities for remote measurement of parameters which characterize near shore water; (2) integration of these parameters into a system which will make possible the definition of circulation characteristics; (3) conduct of applications experiments; and (4) definition of hardware development requirements and/or system specifications. Efforts have emphasized: (1) development of a satisfactory system of gathering ground truth over the entire area of Mississippi Sound to aid in evaluating remotely sensed data; (2) conduct of two data acquisition experiments; (3) analysis of individual sensor data from completed flights; and (4) pursuit of methods which will allow interrelations between data from individual sensors in order to add another dimension to the study. Author

N72-29315* National Aeronautics and Space Administration. Mississippi Test Facility, Bay Saint Louis.
SUMMARY OF 1971 LAND REMOTE SENSING INVESTIGATIONS
Darden Wayne Mooneyhan *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 35 p Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 08G

Techniques to provide land use up-date information using remotely sensed data and automatic data processing technology are being developed. The approach utilizes multispectral scanners, the associated data analysis station, and the pattern recognition programs to identify and classify land surface characteristics, including wetlands, and to convert these data to demonstration type experiments in the various disciplines. Author

N72-29316* National Aeronautics and Space Administration. Mississippi Test Facility, Bay Saint Louis.
SUMMARY OF 1971 PATTERN RECOGNITION PROGRAM DEVELOPMENT **c08**
Sidney Lanier Whitley *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 33 p (For availability see N72-29302 20-13)
CSCL 09B

Eight areas related to pattern recognition analysis at the Earth Resources Laboratory are discussed: (1) background; (2) Earth Resources Laboratory goals; (3) software problems/limitations; (4) operational problems/limitations; (5) immediate future capabilities; (6) Earth Resources Laboratory data analysis system; (7) general program needs and recommendations; and (8) schedule and milestones. Author

N72-29317* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LEWIS RESEARCH CENTER EARTH RESOURCES PROGRAM
Herman Mark *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 21 p (For availability see N72-29302 20-13)
CSCL 08L

The Lewis Research Center earth resources program efforts are in the areas of: (1) monitoring and rapid evaluation of water quality; (2) determining ice-type and ice coverage distribution to aid operations in a possible extension of the Great Lakes ice navigation and shipping season; (3) monitoring spread of crop viruses; and (4) extent of damage to strip mined areas as well as success of efforts to rehabilitate such areas for agriculture.
Author

N72-29318* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ENVIRONMENTAL APPLICATIONS ACTIVITY AT MARSHALL SPACE FLIGHT CENTER **c14**
Charles T. N. Paludan *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 12 p ref (For availability see N72-29302 20-13)
CSCL 14B

MSFC environmental applications demonstration projects have emphasized application of aerospace technology to community needs of southeastern U.S. Some of the typical projects underway are: hydrological parameter determination; land use surveys; agricultural stress detection; new community site surveys; pollution monitoring; urban transportation studies; and urban environmental quality. Author

N72-29319* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EARTH RESOURCES PROGRAMS AT THE LANGLEY RESEARCH CENTER. PART 1: ADVANCED APPLICATIONS FLIGHT EXPERIMENTS (AAFE) AND MICROWAVE REMOTE SENSING PROGRAM
Robert N. Parker *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 12 p (For availability see N72-29302 20-13)
CSCL 08G

The earth resources activity is comprised of two basic programs as follows: advanced applications flight experiments, and microwave remote sensing. The two programs are in various stages of implementation, extending from experimental investigations within both the AAFE program and the microwave remote sensing program, to multidisciplinary studies and planning. The purpose of this paper is simply to identify the main thrust of the Langley Research Center activity in earth resources. Author

N72-29320* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EARTH RESOURCES PROGRAMS AT THE LANGLEY RESEARCH CENTER. PART 2: COASTAL ZONE OCEANOGRAPHY PROGRAM
Walter E. Bressette *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 24 p Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 08J

The approaches used to develop the coastal zone oceanic research program are outlined, and activities in the areas of satellite application, estuaries, continental shelf and environmental modeling are briefly described. Author

N72-29321* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APPLICATIONS EXPERIMENTS IN THE HOUSTON REGION
Bryan R. Erb *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 20 p Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 08H

Organization, staffing, and planning for experimental applications of remote sensing data to gain land use and water management information are described. Work was started on an experimental data base, aerial multispectral photography, and forest and wild life surveys as part of a regional inventory and monitory program. G.G.

N72-29322* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
PUBLIC HEALTH APPLICATIONS OF REMOTE SENSING **c04**
Charles E. Fuller *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 20 p Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 06C

Remote infrared and multispectral photography were used to identify coastal salt water-fresh water interfaces conducive to encephalitis vector mosquito breeding in Florida, and to determine the environmental conditions that caused an explosive outbreak

of anthrax in Louisiana. Multiband photographic inventories were obtained by simultaneously processing three photographic negatives of the same view which record different wavelength portions of the same light. The process enhances differentiation of vegetative communities and sharply deliniates edge effects by assigning false colors to differentiate subtle density differences.
G.G.

N72-29323* Lockheed Electronics Co., Houston, Tex.
CONSTRUCTING AND MANIPULATING COLOR IMAGERY FROM DIGITAL DATA **c14**
J. E. Davis, C. A. Helmke, T. R. Kell, M. J. Arldt, and E. L. Wilson *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 29 p Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 14E

The development of a multispectral scanner data analysis console is reported that incorporates a wideband tape unit, a teletypewriter, a digital computer, and color display as well as numeric display terminals. The device is able to digitize infrared scanner images and displays color differences according to signal differences between analog channels. G.G.

N72-29324* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SALINITY SURVEYS USING AN AIRBORNE MICROWAVE RADIOMETER
J. F. Paris (Lockheed Electron., Houston, Tex.), J. D. Droppleman (Lockheed Electron., Houston, Tex.), and D. E. Evans *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 27 p refs (For availability see N72-29302 20-13)
CSCL 08H

The Barnes PRT-5 infrared radiometer and L-band channel of the multifrequency microwave radiometer are used to survey the distribution of surface water temperature and salinity. These remote sensors were flown repetitively in November 1971 over the outflow of the Mississippi River into the Gulf of Mexico. Data reduction parameters were determined through the use of flight data obtained over a known water area. With these parameters, the measured infrared and microwave radiances were analyzed in terms of the surface temperature and salinity.
Author

N72-29325* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MICROWAVE BRIGHTNESS TEMPERATURE OF A WINDBLOWN SEA
Forrest G. Hall *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 22 p refs (For availability see N72-29302 20-13)
CSCL 08J

A mathematical model is developed for the apparent temperature of the sea at all microwave frequencies. The model is a numerical model in which both the clear water structure and white water are accounted for as a function of wind speed. The model produces results similar to Stogryn's model at 19.35 GHz for wind speeds less than 8 m/sec; it can use radiosonde data to calculate atmospheric effects and can incorporate an empirically determined antenna gain pattern. The corresponding computer program is of modular design and the logic of the main program is capable of treating a horizontally inhomogeneous surface or atmosphere. It is shown that a variation of microwave brightness temperature with zenith angle is necessary to produce the wind sensitivity of the horizontally polarized brightness temperature; the variation of sky temperature with frequency is sufficient to produce a frequency dependent wind sensitivity. Author

N72-29326* Lockheed Electronics Co., Houston, Tex.
DETECTION OF OIL SPILLS USING 13.3 GHz RADAR SCATTEROMETER **c07**
K. Krishen *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 27 p refs Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 17I

The results of an analysis of 13.3-GHz single polarized scatterometer data collected during NASA/MSC Mission 135, flown on March 16, 1970 are reported. Data were gathered over a crude oil spill on the Gulf of Mexico off the Mississippi Delta. With the aid of RC-8 camera photographs, the scattering cross section was correlated with the extent of the oil spill. The scattering cross section at higher incidence angles decreased by 5 db to 10 db in the presence of the oil spill. This was attributed to oil's damping of small gravity and capillary waves. The composite scattering theory and the scatterometer acquired data were used to obtain an expression of radar scattering over ocean surfaces with oil spills. The study demonstrates that the presence and extent of oil spills can be detected using high frequency radar systems. Author

N72-29327*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FOURTH ANNUAL EARTH RESOURCES PROGRAM REVIEW. VOLUME 2: UNIVERSITY PROGRAMS
21 Jan. 1972 606 p refs Rev. held in Houston, Tex., 17-21 Jan. 1972 Original contains color illustrations
(NASA-TM-X-68397; MSC-05937-Vol-2) Avail: NTIS HC $30.50 CSCL 08G

University research work for the Earth Resources Program centered on automatic data processing techniques to extract information from multispectral scanner data on remotely sensed objects of user interest; water management, crop identification, land use, and environmental pollution aspects were emphasized. For individual titles, see N72-29328 through N72-29354.

N72-29328* Michigan Univ., Ann Arbor. Willow Run Labs.
A SUMMARY OF MICHIGAN PROGRAM FOR EARTH RESOURCE INFORMATION SYSTEMS **c34**
Jon D. Erickson *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 19 p refs (For availability see N72-29327 20-13)
CSCL 05B

A summary and guide to the development of earth resources information systems which employ multispectral remote sensing are reported. Major areas of activities center on improved throughput parallel processing systems, improved processing techniques, practical use of techniques in user applications, and improved sensors. Cost effectiveness considerations point to signature extension, parallel processing all-digital computers, and airborne multispectral imaging radar as some of the improvement technologies. G.G.

N72-29329* Michigan Univ., Ann Arbor. Willow Run Labs.
INFORMATION EXTRACTION TECHNIQUES FOR MULTI-SPECTRAL SCANNER DATA
William A. Malila, Robert B. Crane, Wyman Richardson, and Robert E. Turner *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 33 p refs (For availability see N72-29327 20-13)
CSCL 05B

Multispectral data recognition and information extraction problems considered are: (1) signature extension for improved recognition processing over large areas; (2) choice of density functions for recognition decision rules; (3) channel selection for cost reduction; and (4) radiation balance mapping for interpretation of wide spectrum scanner data. The formulation of a simulation model and reprocessing of both aircraft and space data reduces scan angle variations and extends signatures from one altitude to another. Comparison of the usefulness of empirical density functions and that of Gaussian density functions for recognition processing establishes the advantages of normal assumption for individual fields in processing of multispectral scanner data. Also reported is a procedure for producing radiation balance maps from wide spectra by analyzing energy budgets of vegetation and

other surface materials through partitioning net absorbed radiant energy and estimating incoming power density at both short and long wavelengths. G.G.

N72-29330* Michigan Univ., Ann Arbor.
USER ORIENTED MULTISPECTRAL DATA PROCESSING AT THE UNIVERSITY OF MICHIGAN
Frederick J. Thomson *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 22 p refs Original contains color illustrations (For availability see N72-29327 20-13)
(Rept-03165-100-S) CSCL 05B

The feasibility of solving practical multispectral data reduction problems by available processing techniques and the identification of areas for more technical development requirements are considered. Parameter mapping and ratio mapping techniques prove their usefulness in a corn blight watch experiment. A hybrid computer processing system is advocated for complete realization of aircraft and spacecraft sensor potentials. G.G.

N72-29331* Michigan Univ., Ann Arbor. Willow Run Labs.
PREDICTION OF DIRECTIONAL REFLECTANCE OF A CORN FIELD UNDER STRESS
Gwynn H. Suits, Gene Safir (Mich. State Univ.), and A. Ellingboe (Mich. State Univ.) *In* Nasa. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 11 p ref (For availability see N72-29327 20-13)
CSCL 02C

A vegetative canopy model concept is developed and used to calculate the directional spectral reflectance of a corn field under stress. The problem has been idealized by assuming that the canopy is represented in several layers of uniform but randomly distributed biological components; horizontal and vertical projection of leaves, for example, replaces the actual leaf. An accumulative horizontal projection leads to a quantitative horizontal leaf area index while accumulated vertical projections provide the vertical leaf index area for each layer. The spectral properties of the projections are obtained from the spectral properties of the biological components. These techniques together with soil reflectance data provide a physical description for the vegetative canopy and adequately interpret multispectral scanning data. G.G.

N72-29332* Michigan Univ., Ann Arbor. Willow Run Labs.
CLASSIFICATION OF SPATIALLY UNRESOLVED OBJECTS **c14**
Richard F. Nalepka, Harold M. Horwitz, Peter D. Hyde, and James P. Morgenstern *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 13 p (For availability see N72-29327 20-13)
(Contract NAS9-9784)
CSCL 14E

A proportion estimation technique for classification of multispectral scanner images is reported that uses data point averaging to extract and compute estimated proportions for a single average data point to classify spatial unresolved areas. Example extraction calculations of spectral signatures for bare soil, weeds, alfalfa, and barley prove quite accurate. G.G.

N72-29333* Michigan Univ., Ann Arbor. Willow Run Labs.
EXPERIMENTAL METHODS FOR GEOLOGICAL REMOTE SENSING
Robert K. Vincent *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 12 p refs Original contains color illustrations (For availability see N72-29327 20-13)
CSCL 08G

During the past year a two channel IR technique for discrimination among silicate rocks was tested for a second time, a three channel IR method was tested for the first time, and a new visible-reflective IR ratio method was hypothesized and qualitatively tested for iron oxide recognition. Both the two channel and three channel IR ratios methods were capable of discriminating felsic from mafic rock types. The three-channel ratio values measured by the scanner were found to agree, within reasonable limits, with the values of R calculated from laboratory data. The capability of the three channel method to obtain absolute ratios is accompanied by a costly processing routine. The two channel technique is superior for low thermal contrast scenes about which some ground truth is available because of its speed and economy. Author

N72-29334* Michigan Univ., Ann Arbor.
MICHIGAN EXPERIMENTAL MULTISPECTRAL SCANNER SYSTEM
Philip G. Hasell, Jr. *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 13 p (For availability see N72-29327 20-13)
CSCL 08B

A functional description of a multispectral airborne scanner system that provides spectral bands along a single optical line of sight is reported. The airborne scanner consists of an optical telescope for scanning plane perpendicular to the longitudinal axis of the aircraft and radiation detectors for converting radiation to electrical signals. The system makes a linear transformation of input radiation to voltage recorded on analog magnetic tape. G.G.

N72-29335* Michigan Univ., Ann Arbor. Willow Run Labs.
MULTISPECTRAL IMAGING RADAR **c07**
L. J. Porcello and R. A. Rendleman *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 18 p (For availability see N72-29327 20-13)
(Contract NAS9-11106)
CSCL 17I

A side-looking radar, installed in a C-46 aircraft, was modified to provide it with an initial multispectral imaging capability. The radar is capable of radiating at either of two wavelengths, these being approximately 3 cm and 30 cm, with either horizontal or vertical polarization on each wavelength. Both the horizontally- and vertically-polarized components of the reflected signal can be observed for each wavelength/polarization transmitter configuration. At present, two-wavelength observation of a terrain region can be accomplished within the same day, but not with truly simultaneous observation on both wavelengths. A multiplex circuit to permit this simultaneous observation has been designed. A brief description of the modified radar system and its operating parameters is presented. Emphasis is then placed on initial flight test data and preliminary interpretation. Some considerations pertinent to the calibration of such radars are presented in passing. Author

N72-29336* Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.
SPACE CONFIGURATION AS AN EXPLANATION FOR LITHOLOGY-RELATED CROSS-POLARIZED RADAR IMAGE ANOMALIES **c07**
James R. McCauley *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 9 p refs (For availability see N72-29327 20-13)
(Contract NAS9-10261)
CSCL 17I

Three rock types are described that produce dark cross-polarized images on Ka-band imagery: lava flows dating from Pleistocene and Holocene, some Tertiary volcanics, and certain massive sandstones. Their planar surfaces are large with respect to the wavelength of the Ka-band system, yet are small in comparison to the resolution. It is found that only outcrops with proper faceted surface orientations produce significant radar returns showing the dominance of specular reflectors. The omnidirectional attitude of the facets and their wide distribution on the outcrops explains the independence of look-direction that the flat-lying anomalous outcrops exhibit in production of darker cross-polarized images. G.G.

N72-29337* Kansas Univ./Center for Research, Inc., Lawrence.
THE STATUS OF PARAMETRIC STUDIES IN RADAR AGRICULTURE **c07**
Stanley A. Morain *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 17 p refs (For availability see N72-29327 20-13)
(Contract NAS9-10261)
CSCL 17I

Outlined is an information system based on the use of remote sensor data and the design, testing, and implementation of interpretation keys for agriculture. The task of crop identification from radar imagery emphasizes dichotomous keys and the effects of frequency, angular and other microwave dependencies of crops for use in discrimination. A mosaic is formulated from imagery and used to study acres in wheat for spread of circular irrigation, spread of crops, and other phenomena. G.G.

N72-29338* Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.
DATA PROCESSING AT THE UNIVERSITY OF KANSAS **c08**
Robert M. Haralick *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 33 p refs Original contains color illustrations (For availability see N72-29327 20-13)
CSCL 09B

Two systems for processing remotely sensed image data have been discussed. The first system, IDECS, is a near real-time hardware system oriented towards processing multi-image data sets quickly and economically. The IDECS has convenient film input and color display output capabilities and implements simple kinds of decision rules. The second system, KANDIDATS, is a software system capable of performing many of the more sophisticated processing methods. Because of its monitor which handles all bookkeeping and its modular design, KANDIDATS easily allows the testing of new automatic processing techniques. After a new technique has been proven on KANDIDATS, it may be simplified and hard-wired in IDECS, thereby keeping the volume processing of remotely sensed data always up to the current state-of-the-art. Author

N72-29339* Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.
RADAR SIGNATURE AND SYSTEMS STUDIES AT KANSAS UNIVERSITY **c07**
Richard K. Moore *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 37 p Original contains color illustrations (For availability see N72-29327 20-13)
CSCL 17I

The radar signature and systems studies described have concentrated in two areas: octave bandwidths radar spectrometry using a truck-mounted system, and scatterometry using primarily the 13.3 GHz system on aircraft. In addition, the results of the experiments to date have been synthesized into a pair of representative designs for spacecraft radar systems: one for small spacecraft and one for large spacecraft. Author

N72-29340* California Univ., Berkeley. Space Sciences Lab.
AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA USING REMOTE SENSING TECHNIQUES **c14**
Robert N. Colwell *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 24 p refs (For availability see N72-29327 20-13)
CSCL 14B

Remote sensing activities for the management of California's water project are reported. Integrated efforts are based largely on airborne remote sensing data processing to inventory the various kinds of earth resources observed. Work centered on defining parameters pertinent to determine water yield and discernible through remote sensing techniques; (2) determining accuracy in measuring and mapping parameters using remote sensing data flown to various specifications; and (3) relating water yield predictions to actual water yields. Remote sensing imagery of the Perris valley shows that land developers established a number of locations to promote present agricultural land for non-agricultural land use. G.G.

N72-29341* South Dakota State Univ., Brookings. Remote Sensing Inst.
REMOTE SENSING OF SOILS, LAND FORMS, AND LAND USE IN THE NORTHERN GREAT PLAINS IN PREPARATION FOR ERTS APPLICATIONS
C. J. Frazee, F. C. Westin, J. Gropper, and V. I. Myers *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 27 p refs Original contains color illustrations (For availability see N72-29327 20-13)
(Grant NGL-42-003-007)
(RSI-72-02; J-Ser-1070) CSCL 08M

Research to determine the optimum time or season for obtaining imagery to identify and map soil limitations was conducted in the proposed Oahe irrigation project area in South Dakota. The optimum time for securing photographs or imagery is when the soil surface patterns are most apparent. For cultivated areas similar to the study area, May is the optimum time. The fields are cultivated or the planted crop has not yet masked soil surface features. Soil limitations in 59 percent of the field of the flight line could be mapped using the above criteria. The remaining fields cannot be mapped because the vegetation or growing crops do not express features related to soil differences. This suggests that imagery from more than one year is necessary to map completely the soil limitations of Oahe area by remote sensing techniques. Imagery from the other times studied is not suitable for identifying and mapping soil limitations of Oahe area by remote sensing techniques. Imagery from the other times studied is not suitable for identifying and mapping soil limitations because the vegetative cover masked the soil surface and does not reflect soil differences. Author

N72-29342* South Dakota State Univ., Brookings. Remote Sensing Inst.
PATTERN RECOGNITION SYSTEM AND PROCEDURES **c08**
Gerald D. Nelson and David V. Serreyn *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 21 p refs (For availability see N72-29327 20-13)
CSCL 09B

The ratio transformation technique is used to determine effective features as function of time in remote multiple sensing of crops and soils. The selection of quantizer parameters for a two-class recognition problem under the criteria of minimizing the probability of errors is also discussed. Author

N72-29343* Colorado School of Mines, Golden. Geology Dept.
BONANZA PROJECT, 1971 **c08**
Keenan Lee *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 23 p (For availability see N72-29327 20-13)
CSCL 09C

Research on the application of remote sensing techniques to the mineral industry stresses photointerpretation by human interpreter experienced in the extraction of geological information from aerial color and multiband photographs and from thermal scanner imagery. Also considered are optical and digital image enhancement, multiband color additive projection, video image processing, and computer reduction and analysis of infrared spectrometry. Evaluation of those parameters which have the most contrast between adjacent rock formations and which can be remotely sensed establish the following most useful geological characteristics: Topographic landform, color, albedo, and surface temperature. G.G.

N72-29344* Texas A&M Univ., College Station. Remote Sensing Center.
A COACTIVE INTERDISCIPLINARY RESEARCH PROGRAM WITH NASA c08
John W. Rouse, Jr. *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 29 p (For availability see N72-29327 20-13)
CSCL 09B

The applications area of the Texas A&M University remote sensing program consists of a series of coactive projects with NASA/MSC personnel. In each case, the Remote Sensing Center has served to complement and enhance the research capability within the Manned Spacecraft Center. In addition to the applications study area, the Texas A&M University program includes coordinated projects in sensors and data analysis. Under the sensors area, an extensive experimental study of microwave radiometry for soil moisture determination established the effect of soil moisture on the measured brightness temperature for several different soil types. The data analysis area included a project in which ERTS-A and Skylab data were simulated using aircraft multispectral scanner measurements at two altitudes. This effort resulted in development of a library of computer programs which provides an operational capability in classification analysis of multispectral data. Author

N72-29345* Texas A&M Univ., College Station. Remote Sensing Center.
SPECTRAL REFLECTANCE MEASUREMENTS OF A VIRUS HOST MODEL
Robert W. Toler and N. K. Shankar (Lockheed Electronics Co., Houston, Tex.) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 18 p Original contains color illustrations (For availability see N72-29327 20-13)
CSCL 08A

A technique has been developed to detect the characteristic spectral signatures of healthy and infected St. Augustine grass. It is possible to predict the coverage of the infected area provided ground truth coverage shows positive St. Augustine grass turf. Qualitative measurements from photographs of plants in the blue and red regions with polarization show that light reflected from healthy plants is more strongly polarized than that from diseased plants. Photographs taken through the blue Wratten 47 filter in conjuction with a polarizer show an excellent differentiation. A large photographic difference also appears in the red region. Much smaller differences were noted in the 540 to 550 nm region. Although the intensity in the near-IR region is much higher than the visible region of the spectrum, differences in the healthy and diseased plants' reflectance were quite small.
Author

N72-29346* Wisconsin Univ., Madison. Inst. for Environmental Studies.
APPLICATION OF REMOTE SENSING TO WATER RESOURCES PROBLEMS
James L. Clapp *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2, 21 Jan. 1972 40 p Original contains color illustrations (For availability see N72-29327 20-13)
CSCL 08H

The following conclusions were reached concerning the applications of remote sensing to water resources problems: (1) Remote sensing methods provide the most practical method of obtaining data for many water resources problems; (2) the multi-disciplinary approach is essential to the effective application of remote sensing to water resource problems; (3) there is a correlation between the amount of suspended solids in an effluent discharged into a water body and reflected energy; (4) remote sensing provides for more effective and accurate monitoring, discovery and characterization of the mixing zone of effluent discharged into a receiving water body; and (5) it is possible to differentiate between blue and blue-green algae.
Author

N72-29347* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
DIFFERENTIATING ELEMENTS OF THE SOIL-VEGETATION COMPLEX
M. F. Baumgardner *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 24 p refs (For availability see N72-29327 20-13)
(Grant NGL-15-005-112)
CSCL 08M

The application of remote sensing to study soil-vegetation systems requires quantification and precise location of ground observation data such that they can be correlated with multispectral aerial acquired data. Gridding and sampling of an area for exact identification in a known address on magnetic tape containing multispectral scanner data produces quantitative physico-chemical parameters and the energy which is radiating from within the soil-vegetation complex of an area. Example classifications and spectral mappings of soils made from multispectral scanner data are included. G.G.

N72-29348* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
LAND UTILIZATION AND WATER RESOURCE INVENTORIES OVER EXTENDED TEST SITES
Roger M. Hoffer *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 39 p refs Original contains color illustrations (For availability see N72-29327 20-13)
(Grant NGL-15-005-112)
CSCL 08H

In addition to the work on the corn blight this year, several other analysis tests were completed which resulted in significant findings. These aspects are discussed as follows: (1) field spectral measurements of soil conditions; (2) analysis of extended test site data; this discussion involves three different sets of data analysis sequences; (3) urban land use analysis, for studying water runoff potentials; and (4) thermal data quality study, as an expansion of our water resources studies involving temperature calibration techniques. Author

N72-29349* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
MEASUREMENTS PROGRAM IN REMOTE SENSING AT PURDUE UNIVERSITY c14
LeRoy F. Silva *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 33 p refs (For availability see N72-29327 20-13)
(Grant NGL-15-005-112)
CSCL 14B

The measurements program has been concerned with five basic research areas during 1971. These areas are: (1) The influence of haze layers upon remotely sensed surface properties; (2) electrical methods of soil moisture measurement; (3) thermographic studies of vegetation under nutritional stress; (4) improved field spectroradiometry; and (5) biological spectrophotometry. All of these projects have risen out of problems generated from the overall laboratory mission. The emphasis in this paper is on instrumentation and techniques. Author

N72-29350* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
DATA PROCESSING 1: ADVANCEMENTS IN MACHINE ANALYSIS OF MULTISPECTRAL DATA c08
Philip H. Swain *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 13 p refs (For availability see N72-29327 20-13)
(Grant NGL-15-005-112)
CSCL 09B

Multispectral data processing procedures are outlined beginning with the data display process used to accomplish data editing and proceeding through clustering, feature selection criterion for error probability estimation, and sample clustering and sample classification. The effective utilization of large

quantities of remote sensing data by formulating a three stage sampling model for evaluation of crop acreage estimates represents an improvement in determining the cost benefit relationship associated with remote sensing technology. G.G.

N72-29351* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
DATA PROCESSING 2: ADVANCEMENTS IN LARGE SCALE DATA PROCESSING SYSTEMS FOR REMOTE SENSING **c08**
David Landgrebe *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 31 p (For availability see N72-29327 20-13)
(Grant NGL-15-005-112)
CSCL 09B

The development of large scale data processing systems for remote sensing is studied by evaluating: (1) the suitability of several sensor types with regard to producing data required for multispectral machine analysis; (2) various types of data preprocessing necessary to prepare such data for analysis; and (3) transfer of machine processing techniques for earth resources data to user community. G.G.

N72-29352* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OVERVIEW OF THE EARTH RESOURCES PROGRAM OF THE JET PROPULSION LABORATORY
Donald P. Burcham *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 3 p (For availability see N72-29327 20-13)
CSCL 08G

Proposed is an investigation to develop and correlate remote sensing from satellites and aircraft into an effective prototype system for California statewide water quality surveillance. Aircraft overflights, computer enhanced recognition of pollution signatures, ground truth measurements, and data processing will be employed to develop a simplified and automated monitoring system. ERTS A image data will be used for nine major drainage basins of California having unique water quality influences from waste discharges, thermal contributions, oil spills, turbidity, sea water intrusion, agricultural drainage, toxicity, biostimulation, and eutrophication. Author

N72-29353* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MICROWAVE PROPERTIES OF GEOLOGICAL MATERIALS: STUDIES OF PENETRATION DEPTH AND MOISTURE EFFECTS
John C. Blinn, III and Jack C. Quade (Nevada Univ., Reno) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 12 p refs (For availability see N72-29327 20-13)
CSCL 08G

Summarized are the results of two of a series of controlled experiments performed during the summer of 1970. The first series of experiments to determine penetration depth showed the value of having a modeled response and data reduced in real time for examination in the field. The results suggest a radiometric method for measuring the microwave properties of materials in bulk and are applicable to studies of sea ice and other naturally layered media. The sensitivity of the microwave emission to changes in moisture content has inspired a number of airborne and ground based investigations. Although the effect is dominent under certain conditions, the complicating factors of soil type, roughness, vegetation, etc. seem to govern the conclusions regarding its application at this time. Author

N72-29354* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
POLARIZATION EFFECTS WITH A COMBINED RADAR-RADIOMETER **c14**
David Martin *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 12 p (For availability see N72-29327 20-13)
CSCL 14B

Described is a unique microwave sensor. The device uses a coherent X-band radar, a radiometer at the same wavelength and an antenna with a polarization that can be varied electronically. This microwave sensor was developed to acquire polarization signature information about various surfaces in both the active and passive mode simultaneously. One application for the sensor is expected to be the location and identification of plant life.
Author

N72-29355*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FOURTH ANNUAL EARTH RESOURCES PROGRAM REVIEW. VOLUME 3: US GEOLOGICAL SURVEY PROGRAMS
21 Jan. 1972 309 p refs Rev. held at Houston, Tex., 17-21 Jan. 1972 Original contains color illustrations
(NASA-TM-X-68398; MSC-05937-Vol-3) Avail: NTIS HC $17.50 CSCL 08G

A review of various aspects of the Earth Resources Program is presented. Particular attention was given to the results of analysis of data obtained with Manned Spacecraft Center and other aircraft which have contributed to the program. Data cover geology, geography, hydrology, agriculture, forestry, and oceanography. For individual titles, see N72-29356 through N72-29377.

N72-29356* Geological Survey, Menlo Park, Calif.
SATELLITE RELAY TELEMETRY IN THE SURVEILLANCE OF ACTIVE VOLCANOES AND MAJOR FAULT ZONES **c07**
Jerry P. Eaton and Peter L. Ward *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 17 p refs (For availability see N72-29355 20-13)
CSCL 09F

A review was made of efforts to develop a dense telemetered microearthquake network to study earthquake mechanics along the San Andreas fault and the strain mechanics of the Kilauea Volcano. The principle elements and objectives of the ERTS-A proposal are outlined. Some of the aspects of the earthquake network and the results obtained from it as well as some promising experiments in computerized record processing are discussed. Author

N72-29357* Geological Survey, Denver, Colo.
GEOLOGICAL MATERIAL DISCRIMINATION FROM NIMBUS SATELLITE DATA
H. A. Pohn, T. W. Offield, and Kenneth Watson *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 15 p refs Original contains color illustrations (For availability see N72-29355 20-13)
CSCL 08G

An analysis was made of Nimbus satellite data to determine its suitability in determining the physical properties of surface materials. Attempts were also made to use these data in developing analytical techniques for handling data from other earth resources and meteorological satellites. Author

N72-29358* Geological Survey, Denver, Colo.
NEAR INFRARED IRON ABSORPTION BANDS: APPLICATIONS TO GEOLOGIC MAPPING AND MINERAL EXPLORATION
Lawrence C. Rowan *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 18 p refs Original contains color illustrations (For availability see N72-29355 20-13)
CSCL 08G

A spectroscopic analysis of the difference in reflectance of iron-rich and iron-poor minerals was made. Attempts were made to use these minima contrast in geological mapping and metallic mineral exploration of large areas from near infrared and visible satellite images. Data cover pertinent laboratory spectroscopic

investigations, applications of spectral differences to the discrimination of two important metamorphic rock types, and mineral exploration by aircraft in Beartooth Mountains, Montana.
Author

N72-29359* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MAPPING OF TERRAIN BY COMPUTER CLUSTERING TECHNIQUES USING MULTISPECTRAL SCANNER DATA AND USING COLOR AERIAL FILM
Harry W. Smedes (Geological Survey, Denver), Harold J. Linnerud (E G and G, Inc., Bedford, Mass.), Lawrence B. Woolaver (E G and G, Inc., Bedford, Mass.), Ming-Yang Su (Northrop Services, Inc., Huntsville, Ala.), and Robert R. Jayroe *In its* 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 30 p refs Original contains color illustrations (For availability see N72-29355 20-13)
CSCL 08B

Two clustering techniques were used for terrain mapping by computer of test sites in Yellowstone National Park. One test was made with multispectral scanner data using a composite technique which consists of (1) a strictly sequential statistical clustering which is a sequential variance analysis, and (2) a generalized K-means clustering. In this composite technique, the output of (1) is a first approximation of the cluster centers. This is the input to (2) which consists of steps to improve the determination of cluster centers by iterative procedures. Another test was made using the three emulsion layers of color-infrared aerial film as a three-band spectrometer. Relative film densities were analyzed using a simple clustering technique in three-color space. Important advantages of the clustering technique over conventional supervised computer programs are (1) human intervention, preparation time, and manipulation of data are reduced, (2) the computer map gives unbiased indication of where best to select the reference ground control data, (3) use of easy to obtain inexpensive film, and (4) the geometric distortions can be easily rectified by simple standard photogrammetric techniques.
Author

N72-29360* Arizona Univ., Tucson. Office of Arid Land Studies.
FUNCTIONS AND ACTIVITIES OF THE ARIZONA REGIONAL ECOLOGICAL TEST SITE
L. K. Lepley *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 6 p (For availability see N72-29355 20-13)
CSCL 08G

The Arizona Regional Ecological Test Site (ARETS) project and its efforts to coordinate and transfer satellite remote sensing techniques to solving earth resources and environmental problems in the Arizona area are discussed. Project objectives include: (1) establishing a multidiscipline resources and environment team in Arizona capable of applying satellite and supporting aircraft data to expedite remote sensing technology transfer to user agencies; (2) determine future resources and environment information needs for Arizona; (3) conduct coordinated multidiscipline experiments in the use of ERTS data; and (4) provide and recommend facilities, instruments, and training necessary to support the practical uses of remote sensing data.
Author

N72-29361* Geological Survey, Phoenix, Ariz. Water Resources Div.
APPLICATIONS OF REMOTE SENSOR DATA BY STATE AND FEDERAL USER AGENCIES IN ARIZONA
Herbert H. Schumann *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 10 p (For availability see N72-29355 20-13)
CSCL 08G

The use of NASA high altitude aerial photography of south eastern Arizona to develop a natural resources information system for Federal lands is discussed. The data are to be used by local, State, and Federal agencies in connection with geologic mapping projects, water resources investigations, and land use studies to determine the alignment of a proposed major aqueduct. In addition, the data are used to confirm land ownership boundaries, detect changes in land use, and legislative reappointment mapping. Other applications include mapping vegetive cover, evaluation of changes in wildlife habitat, location of deer kills, and as a base for recording telemetry data from radio-collared big game animals.
Author

N72-29362* Bureau of Land Management, Washington, D.C.
REMOTE SENSING ON INDIAN AND PUBLIC LANDS
Grover B. Torbert and Arthur M. Woll (Bur. of Indian Affairs, Washington, D. C.) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 7 p (For availability see N72-29355 20-13)
CSCL 08G

The use of remote sensing techniques by the Bureaus of Indian Affairs and Land Management in planning resource problems, making decisions, writing environmental impact statements, and monitoring their respective programs is investigated. For Indian affairs, data cover the Papago, Fort Apache, San Carlos, and South Dakota Reservations. For the Land Management Office, data cover cadastral surveys, California desert study, range watersheds, and efforts to establish a natural resources information system.
E.H.W.

N72-29363* Bureau of Mines, Pittsburgh, Pa.
THE REMOTE SENSING OF AIR POLLUTION FROM COAL UTILIZATION **c20**
Brian M. Harney, Donald H. McCrea, and Albert J. Forney *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 14 p refs Original contains color illustrations (For availability see N72-29355 20-13)
CSCL 04B

An investigation was made to determine the feasibility of applying earth resources data to the detection of air pollution, particularly pollution from coal burning. Efforts were also made to detect any damage caused by such pollution to vegetation growth and tree life. Results show that vegetative vigor even at low ambient concentrations was damaged and that Eastern white pine trees were severely damaged by the pollutants.
Author

N72-29364* Bureau of Reclamation, Denver, Colo.
REMOTE SENSING OF WET LANDS IN IRRIGATED AREAS
Herbert H. Ham *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 10 p refs (For availability see N72-29355 20-13)
CSCL 08H

The use of airborne remote sensing techniques to: (1) detect drainage problem areas, (2) delineate the problem in terms of areal extent, depth to the water table, and presence of excessive salinity, and (3) evaluate the effectiveness of existing subsurface drainage facilities, is discussed. Experimental results show that remote sensing, as demonstrated in this study and as presently constituted and priced, does not represent a practical alternative as a management tool to presently used visual and conventional photographic methods in the systematic and repetitive detection and delineation of wetlands.
Author

N72-29365* Colorado State Univ., Fort Collins.
SHORT PULSE RADAR MEASUREMENTS OF LAYERED ICE AND SNOW
R. S. Vickers and G. C. Rose *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol 3 21 Jan. 1972 20 p refs (For availability see N72-29355 20-13)
(Contract DI-14-06-D-7159)
CSCL 08L

Using a radar system with high range resolution, it was shown that measurements of snow and ice thickness are feasible with an accuracy of better than 3 inches. In addition, the water equivalent of the snowpack can be estimated, given a single

surface measurement of the snow depth. Discontinuities in density were also detected and their location determined by inspection of the radar returns. The remote measurement of layer thickness is described. The system was designed for eventual incorporation into a light aircraft. Author

N72-29366* Geological Survey, Washington, D.C.
EARTH RESOURCES CARTOGRAPHY PROGRAM
Alden P. Colvocoresses *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 8 p Original contains color illustrations (For availability see N72-29355 20-13)
CSCL 08B

Progress is reported on efforts to develop techniques of using space vehicle and high altitude aircraft imagery in cartography projects. Major efforts were made to develop an operational system for isolating specified themes from the imagery. E.H.W.

N72-29367* Geological Survey, McLean, Va. Topographic Div.
AUTOMATIC THEMATIC MAPPING IN THE EROS PROGRAM
Dean J. Edson *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 13 p (For availability see N72-29355 20-13)
CSCL 08B

A specified approach to the automatic extraction and cartographic presentation of thematic data contained in multispectral photographic images is presented. Experimental efforts were directed toward the mapping of open waters, snow and ice, infrared reflective vegetation, and massed works of man. The system must also be able to process data from a wide variety of sources. Author

N72-29368* Geological Survey, Washington, D.C.
THE GEOGRAPHY AND HUMAN CULTURAL RESOURCES WORKING GROUP OF THE EROS PROGRAM
Arch C. Gerlach *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 4 p (For availability see N72-29355 20-13)
CSCL 08F

The functions, activities, and objectives of the Geography and Human-Cultural Resources Working Group of the EROS program are outlined. The Group's primary function is to coordinate remote sensing experiments of physical scientists and the needs of socioeconomic and culturally orientated planners, policy makers, administrators, and other user groups. Other functions of the Group include land use analysis, resource mapping, and development of an operational automatic information system receptive to land use and environmental data. E.H.W.

N72-29369* Geological Survey, Washington, D.C. Geographic Applications Program.
AN AUTOMATED MAP AND MODEL OF LAND USE IN THE PHOENIX QUADRANGLE
John L. Place *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 19 p (For availability see N72-29355 20-13)
CSCL 08B

Efforts to develop an automated system, from ERTS data, for producing computer models and computer maps of land use and other environmental factors for the Phoenix quadrangle are outlined. E.H.W.

N72-29370* Geological Survey, Washington, D.C. Geographic Applications Program.
CENTRAL ATLANTIC REGIONAL ECOLOGICAL TEST SITE
Robert H. Alexander *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol 3 21 Jan. 1972 23 p refs Original contains color illustrations (For availability see N72-29355 20-13)
CSCL 08G

The work of the Central Atlantic Regional Ecological Test Site (CARETS) project is discussed. The primary aim of CARETS is to test the hypothesis that data from ERTS-A can be made an integral part of a regional land resources information system, encompassing both inventory of the resource base and monitoring of changes, along with their effects on the quality of the environment. Another objective of the project is to determine scaling factors for developing land use information and regional analysis for regions of any given size. Author

N72-29371* Geological Survey, Washington, D.C. Geographic Applications Program.
THE CENSUS CITIES PROJECT: A STATUS REPORT FOR 1971 c14
James R. Wray *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 21 p Original contains color illustrations (For availability see N72-29355 20-13)
CSCL 14E

Work done by the Census Cities Project during 1971 is outlined. The project is designed to detect urban changes in land resource utilization from remote high altitude aircraft and earth orbiting satellite sensors, aid metropolitan regional planners, and provide urban land use maps for various areas. Land use maps are given of several areas observed during 1971. E.H.W.

N72-29372* Geological Survey, Washington, D.C. Geographic Applications Program.
BUREAU AND AGENCY REPORTS
George L. Loelkes *In* NASA. Manned Sapcecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 12 p (For availability see N72-29355 20-13)
CSCL 08F

A summary of the work done by Geography and Human-Cultural Resources Work Group on EROS resources management program is given. Work covers archeological surveys, outdoor recreational planning, and engineering studies. E.H.W.

N72-29373* Geological Survey, Washington, D.C.
WETLANDS DELINEATION BY SPECTRAL SIGNATURE ANALYSIS AND LEGAL IMPLICATIONS
Richard R. Arderson (American Univ., Washington, D. C.) and Virginia Carter *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 9 p (For availability see N72-29355 20-13)
CSCL 08H

High altitude analysis of wetland resources and the use of such information in an operational mode to address specific problems of wetland preservation at a state level are discussed. Work efforts were directed toward: (1) developing techniques for using large scale color IR photography in state wetlands mapping program, (2) developing methods for obtaining wetlands ecology information from high altitude photography, (3) developing means by which spectral data can be more accurately analyzed visually, and (4) developing spectral data for automatic mapping of wetlands. E.H.W.

N72-29374* Geological Survey, Tampa, Fla.
DISCRIMINATION OF FLUORIDE AND PHOSPHATE CONTAMINATION IN CENTRAL FLORIDA FOR ANALYSES OF ENVIRONMENTAL EFFECTS
A. E. Coker, R. Marshall, and F. Thomson (Michigan Univ., Ann Arbor) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 12 p Original contains color illustrations (For availability see N72-29355 20-13)
CSCL 08H

A study was made of the spatial registration of fluoride and phosphate pollution parameters in central Florida by utilizing remote sensing techniques. Multispectral remote sensing data were collected over the area and processed to produce

multispectral recognition maps. These processed data were used to map land areas and waters containing concentrations of fluoride and phosphate. Maps showing distribution of affected and unaffected vegetation were produced. In addition, the multispectral data were processed by single band radiometric slicing to produce radiometric maps used to delineate areas of high ultraviolet radiance, which indicates high fluoride concentrations. The multispectral parameter maps and radiometric maps in combination showed distinctive patterns, which are correlated with areas known to be affected by fluoride and phosphate contamination. These remote sensing techniques have the potential for regional use to assess the environmental impact of fluoride and phosphate wastes in central Florida. Author

N72-29375* Geological Survey, Denver, Colo. Water Resources Div.
APPLICATIONS OF SPECTROSCOPY TO REMOTE DETERMINATION OF WATER QUALITY
Marvin C. Goldberg and Eugene R. Weiner (Denver Univ., Colo.) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 14 p refs (For availability see N72-29355 20-13)
CSCL 08H

The use of remote laser Raman and molecular spectroscopic techniques to measure water quality is examined. Measurements cover biological, chemical, and physical properties of the water. Experimental results show chemical properties are harder to obtain remotely than biological or physical properties and that molecular spectroscopy seems to be the best method for obtaining water quality data. E.H.W.

N72-29376* Missouri Univ., Kansas City. Dept. of Physics.
SPECTRAL REFLECTANCE OF SELECTED AQUEOUS SOLUTIONS FOR WATER QUALITY APPLICATIONS
M. R. Querr, R. C. Waring, W. E. Holland, W. Nijm, and G. M. Hale *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 17 p refs (For availability see N72-29355 20-13)
(Contract DI-14-08-0001-12636)
CSCL 08H

The relative specular reflectances of individual aqueous solutions having a particular chemical salt content were measured in the 2 to 20 micrometers region of the infrared component of radiant flux. Distilled water was the reflectance standard. The angle of incidence was 70.03 deg plus or minus 0.23 deg. Absolute reflectances of the solutions for the same polarization and angle of incidence were computed by use of the measured relative reflectances, one of the Fresnel equations, and the optical constants of distilled water. Phase shift and phase difference spectra were obtained by respectively applying a Kramers-Kronig dispersion analysis to the absolute and relative reflectance spectra. The optical constants of the solutions were determined by algorithms commonly associated with the Kramers-Kronig analysis. Spectral signatures that qualitatively and quantitatively characterize the solute and that show structure of the infrared bands of water were noted in the phase difference spectra. The relative and absolute reflectances, the phase shift and phase difference spectra and the optical constants are presented in graphical form. Application of these results to remote sensing of the chemical quality of natural waters is discussed briefly. Author

N72-29377* Geological Survey, Tucson, Ariz.
QUANTITATIVE RELATIONSHIP BETWEEN REFLECTANCE AND TRANSPIRATION OF PHREATOPHYTES, GILA RIVER TEST SITE
R. C. Culler, J. E. Jones, and R. N. Turner *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 9 p refs (For availability see N72-29355 20-13)
CSCL 08H

The use of IR aerial photographs for determining the dynamic characteristics of evapotranspiration at the Gila River Test Site is discussed. Evapotranspiration was measured as a function of plant volume, surface conditions, soil moisture storage, and ground water levels. E.H.W.

N72-29378*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FOURTH ANNUAL EARTH RESOURCES PROGRAM REVIEW. VOLUME 4: NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION PROGRAMS AND US NAVAL RESEARCH LABORATORY PROGRAMS
21 Jan. 1972 451 p refs Rev. held at Houston, Tex., 17-21 Jan. 1972 Original contains color illustrations
(NASA-TM-X-68563; MSC-05937-Vol-4) Avail: NTIS HC $24.75 CSCL 08E

The Earth Resources Program is reviewed. Papers in the following disciplinary areas are included: geology, geography, hydrology, agriculture, forestry, and oceanography. For individual titles, see N72-29379 through N72-29406.

N72-29379* National Oceanic and Atmospheric Administration, Washington, D.C.
MICROWAVE CHARACTERISTICS OF THE OCEAN SURFACE IN THE 1-10 GHz BAND
Alan E. Strong and Ronald A. Porter (Radiometric Technol. Inc., Wakefield, Mass.) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 19 p refs (For availability see N72-29378 20-13)
CSCL 08C

The microwave characteristics of calm, rough, and foam-covered ocean surfaces were studied, and a technique was developed for deriving thermodynamic ocean surface temperatures from brightness temperatures measured by an earth-orbiting radiometer. This investigation encompassed frequencies in the range 1 to 10 GHz (wavelength range of 30 to 3 cm) and was based on the use of a one-dimensional geometrical optics roughness model, including shadowing and multiple scattering of radiant electromagnetic energy. Provision is made in the model for characterizing surface roughness through the rms slope versus wind velocity relations previously established. Suitable foam and atmospheric models were superimposed on the roughness model. Author

N72-29380* National Oceanic and Atmospheric Administration, Miami, Fla. Sea-Air Interaction Lab.
OBSERVATIONS OF OCEANIC WHITE CAPS FOR MODERATE TO HIGHWIND SPEEDS
Duncan B. Ross and Vincent Cardone (New York Univ., N. Y.) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 20 p refs Original contains color illustrations (For availability see N72-29378 20-13)
CSCL 08C

A series of photographs of sea surface whitecap conditions for wind speeds of 10 to 25 m/sec was obtained and analyzed for areal coverage of white water. The results are in good agreement with semiempirical calculations based on the wind speed and the development of the wave spectrum only when the contribution of thin foam streaks oriented in the direction of the wind is neglected. Since both the actively forming whitecaps and the thin foam streaks contribute significantly to the microwave emissivity of the sea surface, it is important that the foam streaks be included in the theory but differentiated from large white caps and foam patches. A simple relationship that accounts for the foam streaks based on the rate of energy transfer, the wind speed, and the wave spectrum is proposed. By means of empirically derived constant terms for the microwave signatures of white caps and foam streaks, this theory was adapted to the prediction of the increase in brightness temperature due to foam, with reasonable results to wind speeds of 20 m/sec. Author

N72-29381* National Oceanic and Atmospheric Administration, Washington, D.C.
THE CONSTRAINT OF SUN GLINT ON VISIBLE DATA GATHERED BY EARTH SATELLITES
Alan E. Strong *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 13 p refs (For availability see N72-29378 20-13)
CSCL 03B

Sunglint simulation for the ocean surface is considered for selected satellite orbits in an attempt to optimize the selection of an orbit suitable for ocean color measurements. It appears that ocean color sensing by satellite may be most productive during a near-noon polar orbit. Author

N72-29382* National Oceanic and Atmospheric Administration, Washington, D.C.
SPECIAL DISPLAYS OF SATELLITE INFRARED DATA FOR SEA ICE MONITORING
E. Paul McClain *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 11 p refs (For availability see N72-29378 20-13)
CSCL 08L

The NOAA ITOS environmental satellites and their data processing systems are discussed. Sea ice surveillance by satellite and infrared data are considered. K.P.D.

N72-29383* Allied Research Associates, Inc., Concord, Mass.
APPLICATION OF SATELLITE INFRARED MEASUREMENTS TO MAPPING SEA ICE
James C. Barnes *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 6 p (For availability see N72-29378 20-13)
CSCL 08L

The application of the ITOS-SR (scanning radiometer) infrared measurements for mapping sea ice was examined. The work included detailed mapping of ice features visible in the ITOS nighttime DRSR (direct readout scanning radiometer) pictorial data and in Nimbus summertime film strip data. Analyses of digital temperature values from computer printouts of ITOS stored data and from Nimbus data listings were also undertaken, and densitometric measurements of both ITOS and Nimbus data were initiated. Author

N72-29384* Aerojet-General Corp., El Monte, Calif. Microwave Div.
MICROWAVE EMISSION CHARACTERISTICS OF SEA ICE
A. T. Edgerton and G. Poe *In* NASA. Manned Spacecraxt Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 22 p refs Sponsored by NOAA (For availability see N72-29378 20-13)
CSCL 08L

A general classification is presented for sea ice brightness temperatures with categories of high and low emission, corresponding to young and weathered sea ice, respectively. A sea ice emission model was developed which allows variations of ice salinity and temperature in directions perpendicular to the ice surface. Author

N72-29385* National Oceanic and Atmospheric Administration, Washington, D.C.
REGIONAL STUDIES USING SEA SURFACE TEMPERATURE FIELDS DERIVED FROM SATELLITE INFRARED MEASUREMENTS
Alan E. Strong *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 14 p refs (For availability see N72-29378 20-13)
CSCL 08C

Three examples of sea surface temperature distributions over the western Atlantic are presented. These were detected by means of data from the scanning radiometer on the Improved Tiros Operational Satellite 1 (ITOS 1) under relatively clear sky conditions. Author

N72-29386* National Marine Fisheries Service, Bay Saint Louis, Miss.
FISHERIES RESOURCE IDENTIFICATION AND ASSESSMENT STUDIES
William H. Stevenson *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 8 p refs (For availability see N72-29378 20-13)
CSCL 08A

Program coordination activities were shifted from the Space Oceanography Program of NAVOCEANO to the National Environmental Satellite Service as part of NOAA in October 1970. Program activities in remote sensing continued in the development of low-light-level image intensifiers, spectrometers, aerial photography, and lasers for the location, identification, and quantification of living marine resources at or near the sea surface. Other studies included the development of a biologically controlled impoundment for remote sensor investigations and limited activities in fish oil film research. In addition to these remote sensing studies, the National Marine Fisheries Service (NMFS) program at the Mississippi Test Facility is participating in space oceanography studies related to fisheries and in the ERTS-A and Skylab experiments. Aspects of the NMFS program related to fisheries resource identification and assessment during the period 1970 and 1971 are discussed. Author

N72-29387* National Oceanic and Atmospheric Administration, Washington, D.C.
COMPARISON OF REMOTE SENSORS FOR SOIL MOISTURE AND OTHER HYDROLOGIC STUDIES
Donald R. Wiesnet *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 11 p refs (For availability see N72-29378 20-13)
CSCL 08M

Progress in lake temperature and soil moisture remote sensing during 1971. The use of satellite data and imagery for improved flood and low flow forecasts, improved water level and ice reports for the Great Lakes, and better and faster coastal zone storm damage assessment is considered. Author

N72-29388* Aerojet-General Corp., El Monte, Calif. Microwave Div.
SOIL MOISTURE MAPPING BY GROUND AND AIRBORNE MICROWAVE RADIOMETRY
G. Poe and A. T. Edgerton *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 23 p refs (For availability see N72-29378 20-13)
CSCL 08M

Extensive ground-based and airborne investigations were undertaken in conjunction with laboratory dielectric measurements of soils and analytical modeling. Radiometric measurements were made in the vicinity of Phoenix, Arizona at observational wavelengths ranging from 0.81 to 21 cm. Ground experiments were conducted with a microwave field laboratory and airborne measurements were obtained from a CV-990 aircraft. Research activities were focused on establishing basic relationships between microwave emission and the distribution of moisture. Author

N72-29389* National Oceanic and Atmospheric Administration, Washington, D.C.
DETERMINATION OF THAWING SNOW AND ICE SURFACES USING EARTH SATELLITE DATA
Donald R. Wiesnet and David F. McGinnis *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 9 p refs (For availability see N72-29378 20-13)
CSCL 08L

The apparent differential spectral reflectance is reported as sensed by the imaging dissector camera system in the visible portion of the electromagnetic spectrum and by the high resolution infrared radiometer in the near-IR portion of the electromagnetic spectrum. Both instruments were aboard the Nimbus 3 satellite. Author

N72-29390* Allied Research Associates, Inc., Concord, Mass.
SNOW STUDIES USING THERMAL INFRARED OBSERVATIONS FROM EARTH SATELLITES
James C. Barnes *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 7p (For availability see N72-29378 20-13)
CSCL 08L

The application of satellite high resolution infrared data was studied for mapping snow cover. The study has two objectives: (1) to determine whether existing radiometers onboard the Nimbus and ITOS satellites can provide hydrologically useful snow information, and (2) to develop analysis techniques applicable to future IR sensor systems on earth satellites. The IR measurements are being analyzed in conjunction with concurrent satellite photographs and conventional snow cover data. Author

N72-29391* Florida Univ., Gainesville. Dept. of Coastal and Oceanographic Engineering.
LABORATORY INVESTIGATIONS RELATED TO MICROWAVES
Omar H. Shemdin *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 21 p refs (For availability see N72-29378 20-13)
CSCL 08C

The investigation in a laboratory controlled environment was of the structure of the water surface and the immediate layers above and below the surface. The scope included: (1) the investigation of the capillary waves and their interaction with gravity waves, (2) the formation of whitecaps at different wind speeds and the influence of gravity waves on whitecaps, and (3) the wind-generated spray under different wind and wave conditions. Author

N72-29392* New York Univ., N.Y.
THE EXTRAPOLATION OF LABORATORY AND AIRCRAFT RADAR SEA RETURN DATA TO SPACECRAFT ALTITUDES
Willard J. Pierson and Richard K. Moore (Kansas Univ.) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 47 p refs (For availability see N72-29378 20-13)
(Contract N62306-70-A-0075-0007)
CSCL 08C

Laboratory measurements show that the spectra of capillary waves grow with wind speed over six orders of magnitude. The scatter in the data can be partially understood and predicted from a combination of turbulence theory, radar theory, and the small sample theory of statistical inference. When these results are applied to a prediction of the sea return values to be obtained by S193 on Skylab, it can be shown that the size of the illuminated patch effectively averages out the horizontal scales of gustiness, so that the measurement will correspond to the synoptic scale wind. Author

N72-29393* Naval Research Lab., Washington, D.C. E. O. Hulburt Center for Space Research.
MISSION 119 PASSIVE MICROWAVE RESULTS
J. P. Hollinger and R. A. Mennella *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 11 p refs (For availability see N72-29378 20-13)
CSCL 08C

Passive microwave measurements of the sea surface were made for determining surface wind speeds from the NP3A aircraft (NASA-927). Observations were made at frequencies of 1.4, 10.6, and 31.4 GHz during NASA mission 119, undertaken off Bermuda in the vicinity of Argus Island sea tower during January 1970. Passive microwave observations from Argus Island ocean showed that the surface roughness effect, dependent on wind speed, is also dependent on observational frequency, increasing with increasing frequency. The roughness effect appears to be dominant for wind speeds less than 30 to 40 knots (2). Author

N72-29394* Scripps Institution of Oceanography, La Jolla, Calif.
APPLICATION OF THERMAL RADIATION DATA TO FISHERY OCEANOGRAPHY
Merritt Stevenson and Forrest Miller *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 18 p refs (For availability see N72-29378 20-13)
CSCL 08A

Work on Project Little Window-1 and -2, DRIR data conversion, improvements on the APT receiver, equatorial upwelling, and the topic of thermal fronts is discussed. Author

N72-29395* Naval Research Lab., Washington, D.C.
THE CASE FOR OCEAN COLOR
Henry J. Yotko *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 5 p refs (For availability see N72-29378 20-13)
CSCL 08C

The concept of monitoring the plankton-producing areas of the world is discussed in relation to assessing the exchange of CO2/O2 on a world-wide basis as a part of a life-support system. Author

N72-29396* Scripps Institution of Oceanography, San Diego, Calif. Visibility Lab.
DETECTION OF OCEAN CHLOROPHYLL FROM EARTH ORBIT
Seibert O. Duntley *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 25 p refs (For availability see N72-29378 20-13)
CSCL 08A

Calculations were made of the magnitude of the optical signature of ocean chlorophyll available to any remote sensor in earth orbit. It was desired to ascertain whether commercially significant concentrations of chlorophyll-A pigments in the ocean would produce a sufficient optical signal at orbital altitudes to operate optical remote sensors, such as those planned for the earth observatory satellite, on clear and hazy days. It was also desired to explore the effect of solar altitude on these optical signals. The best orientation was desired for the field of view for a remote sensor in orbit in order to optimize its ability to detect ocean chlorophyll. Author

N72-29397* TRW Systems Group, Redondo Beach, Calif.
A TECHNIQUE FOR THE REDUCTION AND ANALYSIS OF OCEAN SPECTRAL DATA
Peter G. White *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 10 p ref (For availability see N72-29378 20-13)
CSCL 08C

Some initial investigations of a method of reducing and analyzing raw ocean spectral data are presented. The method avoids most problems associated with atmospheric effects, and requires the application of little, if any, calibration information to the data. Author

N72-29398* Oregon State Univ., Corvallis. Oceanography Dept.
REMOTE MEASUREMENT OF CHLOROPHYLL CONCENTRATION AND SECCHI-DEPTH USING THE PRINCIPAL COMPONENTS OF THE OCEAN'S COLOR SPECTRUM
James L. Mueller *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 13 p refs (For availability see N72-29378 20-13)
(Contract N62306-70-C-041)
CSCL 08A

Statistical results and conclusions are presented, based on direct comparisons of the ocean's color and chlorophyll concentration. The ocean color and ground truth data for this analysis were collected during Mission 140 of NASA's NP3A earth resources aircraft over the period from 6 through 14

August 1970. During this experiment, chlorophyll and light attenuation data were collected. All sets of comparative observations are simultaneous in the sense that the ship began sampling when the aircraft came overhead. Author

N72-29399* Scripps Institution of Oceanography, San Diego, Calif. Visibility Lab.
SURFACE TRUTH MEASUREMENTS OF OPTICAL PROPERTIES OF THE WATERS IN THE NORTHERN GULF OF CALIFORNIA
Roswell W. Austin *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 21 p refs (For availability see N72-29378 20-13)
CSCL 08C

Gemini and Apollo flight photographs of the southwestern United States and northwestern Mexico, and especially of the Colorado River delta and the northwestern Gulf of California, are considered. The clearly discernible water coloration in the imagery led to the suggestion that remote sensing techniques may be usefully applied in such areas to determine bathymetric information. Measurements of the optical properties of the water in this region obtained in March 1971 showed that generally low transmissivities prevailed and at no station did the beam transmittance for the total water column exceed 2.5 x 10 to the -8th power. It was concluded that any correlation between water depth and spectral radiance at the surface must result from secondarily related phenomena. Author

N72-29400* International Imaging Systems, Mountain View, Calif.
PRACTICAL UTILITY OF THE BLUE SPECTRAL REGION c14
Donald S. Ross *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 29 p refs Original contains color illustrations (For availability see N72-29378 20-13)
CSCL 14E

Some aspects of multispectral photography in the blue region are discussed briefly, and sample images are submitted to demonstrate the potential utility of the blue multispectral record for oceanography. Author

N72-29401* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EVALUATION OF FACTORS AFFECTING RESOLUTION OF SHALLOW WATER BOTTOM FEATURES
Curtis C. Mason, Dean R. Norris, and I. Dale Browne *In its* 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 14 p refs Original contains color illustrations (For availability see N72-29378 20-13)
CSCL 08C

To ensure good aerial photography, the effects that factors such as submergence depth, sun angle, film and filter type, exposure, aircraft altitude, and polarization have on the photographic resolution of an underwater object must be determined. Various subjects were photographed, such as the deck of a small submersible, colored and gray scale panels, and natural bottom features. No underwater resolution target was used. Author

N72-29402* Michigan Univ., Ann Arbor.
MULTISPECTRAL OBSERVATIONS OF MARINE ENVIRONMENTS
Fabian C. Polcyn *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 23 p refs (For availability see N72-29378 20-13)
CSCL 08C

It is demonstrated that the multispectral scanner, using multiple channels in registry and recorded on magnetic tape, can be used in variety of applications in the marine environment. Author

N72-29403* Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.
COASTAL AND ESTUARINE APPLICATIONS OF MULTISPECTRAL PHOTOGRAPHY c14
Edward Yost and Sondra Wenderoth *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 17 p refs Original contains color illustrations (For availability see N72-29378 20-13)
CSCL 14E

An evaluation of multispectral photographic techniques for optical penetration of water in the northeastern United States and the Gulf of Mexico coastal waters is presented. The spectral band (493 to 543 nanom), when exposed to place the water mass at about unit density on the photographic emulsion, was found to provide the best water penetration, independent of altitude or time of day, as long as solar glitter from the surface of the water is avoided. An isoluminous color technique was perfected, which eliminates the dimension of brightness from a multispectral color presentation. Author

N72-29404* Naval Research Lab., Washington, D.C.
A STUDY OF TEMPORAL ESTAURINE FLOW DYNAMICS
Robert L. Mairs and Dennis K. Clark (Naval Oceanographic Office) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 19 p refs Original contains color illustrations (For availability see N72-29378 20-13)
CSCL 08H

Multispectral photography,infrared imagery, image enhancement, and oceanographic, radiometric, and meteorological data were used in the study of temporal estuarine flow dynamics, nearshore circulation, and the resulting dispersal of suspended and dissolved substances introduced from the continent. Repetitive multispectral photography, IR imagery, total radiance and irradiance, water surface temperatures, salinity, total suspended solids, visibility, current velocity, winds, dye implants, and high contrast image enhancement were used to observe and describe water mass boundaries in the nearshore zone and to attempt to establish on what repetitive scale these coastal features should be observed to better understand their behavior. Water mass variability patterns, seen naturally and with the use of dyes, along the North Carolina coast and in the Chesapeake Bay are being studied as synoptic data on the basic dynamics of circulation, flushing, and mixing in coastal waters. Author

N72-29405* Naval Research Lab., Washington, D.C.
THE TONGUE OF THE OCEAN AS A REMOTE SENSING OCEAN COLOR CALIBRATION RANGE
Leo V. Strees *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 13 p refs Original contains color illustrations (For availability see N72-29378 20-13)
CSCL 08C

In general, terrestrial scenes remain stable in content from both temporal and spacial considerations. Ocean scenes, on the other hand, are constantly changing in content and position. The solar energy that enters the ocean waters undergoes a process of scattering and selective spectral absorption. Ocean scenes are thus characterized as low level radiance with the major portion of the energy in the blue region of the spectrum. Terrestrial scenes are typically of high level radiance with their spectral energies concentrated in the green-red regions of the visible spectrum. It appears that for the evaluation and calibration of ocean color remote sensing instrumentation, an ocean area whose optical ocean and atmospheric properties are known and remain seasonably stable over extended time periods is needed. The Tongue of the Ocean, a major submarine channel in the Bahama Banks, is one ocean area for which a large data base of oceanographic information and a limited amount of ocean optical data are available. Author

N72-29406* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A PROGRAM TO ASSESS A THERMAL DISCHARGE ON

TRINITY BAY, TEXAS
James B. Zaitzeff (Naval Res. Lab.) and Victor S. Whitehead *In its* 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jul. 1972 2 p (For availability see N72-29378 20-13)
CSCL 08H

The application of a two dimensional mathematical model to the analysis of the thermal discharge to verify its ability to predict the temperature distribution of Trinity Bay in the vicinity of the water outfall. Basic data consist of aerial thermal infrared and in situ measurements. Author

N72-29407*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FOURTH ANNUAL EARTH RESOURCES PROGRAM REVIEW. VOLUME 5: AGRICULTURE AND FORESTRY PROGRAMS
21 Jan. 1972 281 p refs Rev. held at Houston, Tex., 17-21 Jan. 1972 Original contains color illustrations
(NASA-TM-X-68562; MSC-05937-Vol-5) Avail: NTIS HC $16.25 CSCL 02F

The agriculture and forest earth resources programs are discussed, including the remote sensing equipment and techniques. The corn blight watch experiment is emphasized, among other infestation studies. For individual titles, see N72-29408 through N72-29422.

N72-29408* California Univ., Berkeley. Forestry Remote Sensing Lab.
DEVELOPMENT OF ANALYSIS TECHNIQUES FOR REMOTE SENSING OF VEGETATION RESOURCES c04
William C. Draeger *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 13 p Original contains color illustrations (For availability see N72-29407 20-13)
CSCL 02C

Various data handling and analysis techniques are summarized for evaluation of ERTS-A and supporting high flight imagery. These evaluations are concerned with remote sensors applied to wildland and agricultural vegetation resource inventory problems. Monitoring California's annual grassland, automatic texture analysis, agricultural ground data collection techniques, and spectral measurements are included. J.A.M.

N72-29409* Oregon State Univ., Corvallis. Range Management Program.
RESOURCE ANALYSIS AND LAND USE PLANNING WITH SPACE AND HIGH ALTITUDE PHOTOGRAPHY
Barry J. Schrumpf *In* NASA. Manned Spacecraft Center. 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 11 p refs (For availability see N72-29407 20-13)
CSCL 02C

Photographic scales providing resource data for decision making processes of land use and a legend system for barren lands, water resources, natural vegetation, agricultural, urban, and industrial lands in hierarchical framework are applied to various remote sensing techniques. Two natural vegetation resource and land use maps for a major portion of Maricopa County, Arizona are also produced. J.A.M.

N72-29410* Maine Univ., Orono. Dept. of Botany.
THE USE OF KODAK AEROCHROME INFRARED COLOR FILM, TYPE 2443, AS A REMOTE SENSING TOOL c14
G. R. Cooper, R. L. Bowen (Agricultural Res. Serv., Weslaco, Tex.), and H. W. Gausman (Agricultural Res. Serv., Weslaco, Tex.) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 6 p refs Original contains color illustrations (For availability see N72-29407 20-13)
CSCL 14E

An infrared color film, Kodak Aerochrome, type 2443, has replaced the 8443 film. The 2443 has lower contrast than the 8443 film, and allows deeper probing into areas that appear as solid black shadows on the 8443 film. The cyan layer of 2443 is approximately 1 1/2 stops slower, at a density of 1.4, than the yellow and magenta emulsion layers. Author

N72-29411* Agricultural Research Service, Chickasha, Okla. Southern Plains Branch.
MEASUREMENTS FROM AIRCRAFT TO CHARACTERIZE WATERSHEDS
Bruce J. Blanchard *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 14 p refs (For availability see N72-29407 20-13)
CSCL 08H

Remote sensor measurements of the Southern Plains watershed, an 1130 sq mile segment of the Washita River basin in the Texas Panhandle, are discussed. Soil moisture measurements are emphasized, along with rainfall storage capacity of the soil. Indicators of pond water quality, geologic sources of sediment or salt, and rapid methods of mapping seepage are being searched for through remote sensing. J.A.M.

N72-29412* Agricultural Research Service, Weslaco, Tex. Soil and Water Conservation Research Div.
DISCRIMINANT ANALYSES OF BENDIX SCANNER DATA c08
A. J. Richardson, C. L. Wiegand, R. W. Leamer, A. H. Gerbermann, and R. J. Torline *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 22 p refs (For availability see N72-29407 20-13)
CSCL 09B

Flights over Weslaco, Texas are discussed, using the 9-channel Bendix scanner, providing calibrated data in the 380 to 1000 nm wavelength interval. These flights were at 2000 ft. These data gave seasonal coverage from the time signals, representing mainly the soil background. The ground truth data are provided; signature processing studies relating scanner data to ground truth were also carried out. Author

N72-29413* Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
MICROSCALE PHOTO INTERPRETATION OF FOREST AND NONFOREST LAND CLASSES c14
Robert C. Aldrich and Wallace J. Greentree *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 21 p refs (For availability see N72-29407 20-13)
CSCL 14E

Remote sensing of forest and nonforest land classes are discussed, using microscale photointerpretation. Results include: (1.) Microscale IR color photography can be interpreted within reasonable limits of error to estimate forest area. (2.) Forest interpretation is best on winter photography with 97 percent or better accuracy. (3.) Broad forest types can be classified on microscale photography. (4.) Active agricultural land is classified most accurately on early summer photography. (5.) Six percent of all nonforest observations were misclassified as forest. J.A.M.

N72-29414* Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
POTENTIALITY FOR OBTAINING PORIA DISEASE SIGNATURES IN THE OREGON CASCADES FROM ORBITAL ALTITUDES
John F. Wear *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 19 p (For availability see N72-29407 20-13)
CSCL 02F

A prime photographic signature indicator of an important forest disease was identified in valuable Douglas-fir stands of the Pacific Northwest. The disease signature was verified by a multidisciplinary team of scientists to be the direct result of the Poria weirii root-rot syndrome in the Douglas-fir and hemlock stands of the high Cascades in Oregon. It is readily discernible

on small-scale suborbital photography and has good potential for detection from earth-orbiting satellites or remote sensing platforms. Author

N72-29415* Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.
PATTERN RECOGNITION OF NATIVE PLANT COMMUNITIES: MANITOU COLORADO TEST SITE c08
Richard S. Driscoll *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 28 p refs Original contains color illustrations (For availability see N72-29407 20-13)
CSCL 09B

Optimum channel selection among 12 channels of multispectral scanner imagery identified six as providing the best information about 11 vegetation classes and two nonvegetation classes at the Manitou Experimental Forest. Intensive preprocessing of the scanner signals was required to eliminate a serious scan angle effect. Final processing of the normalized data provided acceptable recognition results of generalized plant community types. Serious errors occurred with attempts to classify specific community types within upland grassland areas. The consideration of the convex mixtures concept (effects of amounts of live plant cover, exposed soil, and plant litter cover on apparent scene radiances) significantly improved the classification of some of the grassland classes. Author

N72-29416* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
CORN BLIGHT WATCH EXPERIMENT RESULTS
C. J. Johannsen and M. E. Bauer *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 23 p Original contains color illustrations (For availability see N72-29407 20-13)
(Grant NGL-15-005-112)
CSCL 02C

Results pertaining to the detection and assessment of the severity and extent of southern corn leaf blight in the Corn Belt area are discussed. Ground observations, interpretation of color infrared photography, and machine analysis of multispectral scanner data were used to identify the blight. Author

N72-29417* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
THE CORN BLIGHT PROBLEM: 1970 AND 1971
Marvin E. Bauer *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 19 p (For availability see N72-29407 20-13)
CSCL 02C

Southern corn leaf blight is caused by the fungus, Helminthosporium maydis. Race T of H maydis adapted itself to the Texas male sterile cytoplasm corn. The problems caused by this variety of the blight in 1970 and 1971 are discussed, as well as the symptoms and development of the disease. J.A.M.

N72-29418* Department of Agriculture, Washington, D.C. Statistical Reporting Service.
CORN BLIGHT REVIEW: SAMPLING MODEL AND GROUND DATA MEASUREMENTS PROGRAM
Richard Allen *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 23 p (For availability see N72-29407 20-13)
CSCL 02C

The sampling plan involved the selection of the study area, determination of the flightline and segment sample design within the study area, and determination of a field sample design. Initial interview survey data consisting of crop species acreage and land use were collected. On all corn fields, additional information such as seed type, row direction, population, planting date, etc were also collected. From this information, sample corn fields were selected to be observed through the growing season on a biweekly basis by county extension personnel. Author

N72-29419* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex. Earth Observations Aircraft Program Office.
AIRCRAFT DATA ACQUISITION
Ronald K. Blilie *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, vol. 5 21 Jan. 1972 9 p (For availability see N72-29407 20-13)
CSCL 02C

The corn blight project was different than previously planned missions in duration, coverage, and sensor configuration. The wide aerial coverage and single sensor configuration provided flexibility in mission operations that contributed to mission success. This project also provided a review of the data on a timely basis permitting sensor corrections to be made and evaluated in the field. Author

N72-29420* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
THE 1971 CORN BLIGHT WATCH EXPERIMENT DATA PROCESSING, ANALYSIS, AND INTERPRETATION
Terry L. Phillips *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 20 p (For availability see N72-29407 20-13)
CSCL 02C

The principle data acquisition centers are listed for the corn blight experiment. A data storage and retrieval system was established. The purpose of the system was to: (1) store data in organized library; (2) maintain a record of all data stored and reduced for future access; (3) report the data in simplest form to users; and (4) record data reduction results from photographic and multispectral scanner sensors. The procedures designed for handling the large amounts of data are also reviewed. J.A.M.

N72-29421* Michigan Univ., Ann Arbor. Willow Run Labs.
DETAILED INTERPRETATION AND ANALYSIS OF SELECTED CORN BLIGHT WATCH DATA SETS
R. F. Nalepka, J. P. Morgenstern, and W. L. Brown *In* NASA. Manned Spacecraft Center 4th ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 26 p Original contains color illustrations (For availability see N72-29407 20-13)
(Contract NAS9-9784)
CSCL 02C

A detailed interpretation and analysis of selected corn blight data set was undertaken in order to better define the present capabilities and limitations of agricultural remote multispectral sensing and automatic processing techniques and to establish the areas of investigation needing futher attention in the development of operational survey systems. While the emphasis of this effort was directed toward the detection of various corn blight levels, problems related to the more general task of crop identification were also investigated. Since the analog recognition computer (SPARC) was fully committed to the more routine aspects of processing and since the detailed interpretation and analysis required more in the way of quantitative information, the CDC 1604 digital computer was employed. Author

N72-29422* Department of Agriculture, Washington, D.C. Program Performance Div.
THE 1971 CORN BLIGHT WATCH EXPERIMENT
J. W. Clifton *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 5 p (For availability see N72-29407 20-13)
CSCL 02C

The successful fulfillment of the objectives for the 1971 corn blight watch experiment is reported. The objectives were: (1) detect the development and spread of corn blight during the growing season across the Corn Belt; (2) assess different levels of infection in the Corn Belt; (3) amplify data acquired by ground observations to better appraise current blight status and the probable impact on crop production; and (4) estimate through extrapolation the applicability of these techniques to similar situations occurring in the future. J.A.M.

N72-29423*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GRAVITATIONAL FIELD MODELS FOR THE EARTH (GEM 1 AND 2)

Francis J. Lerch, Carl A. Wagner, David E. Smith, Mark L. Andson (Computer Sci. Corp., Falls Church, Va.), Joseph E. Brownd (Computer Sci. Corp., Falls Church, Va.), and James A. Richardson (Computer Sci. Corp., Falls Church, Va.) May 1972 41 p refs

(NASA-TM-X-65970; X-553-72-146) Avail: NTIS HC $4.25 CSCL 03B

Two models of the earth's gravitational field have been computed at Goddard Space Flight Center. The first, Goddard Earth Model 1 (GEM 1), has been derived from satellite tracking data. The second, Goddard Earth Model 2 (GEM 2), has been derived from a combination of satellite tracking and surface gravimetric data. The geopotential models are represented in spherical harmonics complete to degree and order 16 for the combined solution and complete to degree and order 12 for the satellite solution. Both solutions include zonal terms to degree 21 and related satellite resonant coefficients to degree 22. The satellite data consisted primarily of optical data processed on 300 weekly orbital arcs for 25 close earth satellites. Surface gravity data were employed in the form of 5 deg x 5 deg mean free-air gravity anomalies providing about 70% world coverage. Station locations were obtained for 46 tracking sites by combining electronic, laser, and additional optical tracking data with the above satellite data. Analysis of the radial positions of these stations and a value of mean gravity on the geoid indicated a mean equatorial radius for the earth of about 6378145 meters. Results of geopotential tests on satellite data not used in the solution show that better agreement was obtained with the GEM 1 and GEM 2 models than with the 1969 Smithsonian Standard Earth 2 model. Author

N72-29424*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A MODIFIED MONTE CARLO MODEL FOR THE IONOSPHERIC HEATING RATES

H. G. Mayr, E. G. Fontheim (NAS-NRC), and S. C. Robertson (Consultants and Designers, Inc., Greenbelt, Md.) Jul. 1972 12 p refs Submitted for publication

(NASA-TM-X-65980; X-621-72-265) Avail: NTIS HC $3.00 CSCL 03B

A Monte Carlo method is adopted as a basis for the derivation of the photoelectron heat input into the ionospheric plasma. This approach is modified in an attempt to minimize the computation time. The heat input distributions are computed for arbitrarily small source elements that are spaced at distances apart corresponding to the photoelectron dissipation range. By means of a nonlinear interpolation procedure their individual heating rate distributions are utilized to produce synthetic ones that fill the gaps between the Monte Carlo generated distributions. By varying these gaps and the corresponding number of Monte Carlo runs the accuracy of the results is tested to verify the validity of this procedure. It is concluded that this model can reduce the computation time by more than a factor of three, thus improving the feasibility of including Monte Carlo calculations in self-consistent ionosphere models. Author

N72-29425*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

BARIUM RELEASE SYSTEM Patent Application

Beverly W. Lewis, Charles S. Stokes (Res. Inst. of Temple Univ.), Edward W. Smith (Res. Inst. of Temple Univ.), and William J. Murphy, inventors (to NASA) (Res. Inst. of Temple Univ.) Filed 28 Apr. 1972 16 p

(NASA-Case-LAR-10670-2; US-Patent-Appl-SN-248761) Avail: NTIS HC $3.00 CSCL 04A

A chemical system was developed for releasing free barium atoms and barium ions. Ion clouds created by the barium release in the upper atmosphere and interplanetary space are also considered. NASA

N72-29426# Grumman Aerospace Corp., Bethpage, N.Y.

STOCHASTIC HYDROLOGY M.S. Thesis - C. W. Post Coll.

R. L. Erath Aug. 1972 33 p refs

(RM-550) Avail: NTIS HC $3.75

It is shown that time series analysis in hydrology is of value in defining the sources of the variables in the hydrologic cycle. The technique outline recognizes the inherent variability of the enviroment and the presence of noise. Better definitions of the interaction between various geophysical processes of the hydrological cycle can be used to form more realistic models of greater utility. It is shown how the concept of coherence is used to remove ambiguities that arise when the sources of noise are traced via spectrum analysis alone. The key element is the use of cross power spectrum to test the phase coherence of the sources. Author

N72-29427*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN INVESTIGATION OF GEOMETRY AND NOISE CORRECTIONS TO SAN MARCO-C NEUTRAL ATMOSPHERIC COMPOSITION EXPERIMENT DATA

Steven A. Curtis Jul. 1972 25 p refs

(NASA-TM-X-65982; X-626-72-269) Avail: NTIS HC $3.25 CSCL 03B

The problem of the calculation of ambient densities from San Marco-C neutral atmospheric composition experiment data is considered. A brief description is given of the data measurement method, followed by a description of both the theoretical and experimental data curves. Geometry, electrometer distortions, and noise effects are then studied in terms of their effects on the ideal data form. From these considerations two data reduction methods are evolved. The first is an iterative integration technique that exploits the symmetry of the experimental data about the minimum angle of attack. For the analysis of geometry effects, a second method using interval averaging was developed and studied. Author

N72-29428*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EQUATORIAL THERMOSPHERIC COMPOSITION AND ITS VARIATIONS

G. P. Newton, D. T. Pelz, and W. T. Kasprzak Aug. 1972 10 p refs Presented at 15th COSPAR Meeting, Madrid, Spain, 22 May 1972

(NASA-TM-X-65981; X-621-72-266) Avail: NTIS HC $3.00 CSCL 03B

The neutral atmospheric composition experiment on the San Marco - 3 satellite has measured the composition of the equatorial atmosphere from 29 April to 29 November 1971. Preliminary results on the diurnal variation of atmospheric composition from 19 May to 30 June at 225 km. altitude are presented. The diurnal variation of helium is seen to reach its maximum near 0800 hours and its minimum in the late afternoon in contrast to the behavior of molecular nitrogen and argon. The atomic oxygen densities show smaller variations than the other gases. The mass densities calculated from the composition data agree well with those determined from the in situ drag force measurements and from orbital decay measurements. Author

N72-29429*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE EQUATORIAL AIRGLOW AND THE IONOSPHERIC GEOMAGNETIC ANOMALY

S. Chandra, E. I. Reed, B. E. Troy, Jr., and J. E. Blamont (CNRS, Verrieres le Buisson, France) Aug. 1972 28 p refs Submitted for publication Original contains color illustrations

(NASA-TM-X-65978; X-621-72-260) Avail: NTIS HC $3.50 CSCL 04A

OGO D observations of OI (6300A) emissions reveal a global pattern in the equatorial airglow undetected from the ground-based observations. The post sunset emission rate of OI is generally asymmetrical with respect to the geomagnetic

equator and shows no apparent correlation with the ultraviolet airglow (OI 1304 and 1356A) and F region electron density measured simultaneously from the same spacecraft. Both the ultraviolet airglow and the ion density measured in the altitude region of 450 km follow similar latitudinal variations and exhibit properties of the equatorial ionospheric anomaly. The asymmetry in OI emission can be attributed to the asymmetry in the height of the F 2 maximum inferred from the height of the maximum emission. From correlative studies of the airglow and the ionospheric measurements, the mechanisms for the ultraviolet and the 6300A emission are discussed in terms of the processes involving radiative and dissociative recombinations. A relationship between molecular oxygen density and the integrated OI emission rate is derived and the feasibility of using this relationship for estimating O2 density is discussed. Author

N72-29430*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC FIELD SIGNATURES OF SUBSTORMS ON HIGH LATITUDES FIELD LINES IN THE NIGHTTIME MAGNETOSPHERE
D. H. Fairfield Jul. 1972 32 p refs Submitted for publication
(NASA-TM-X-65974; X-692-72-243) Avail: NTIS HC $3.75 CSCL 04A

Two types of magnetic field changes are repeatedly observed in the high latitude nightside magnetosphere in association with magnetic substorms. One type is characterized by sudden decrease in the field strength, accompanied by an abrupt perturbation in the field declination angle. These changes are attributed to field aligned-sheet currents flowing on the high latitude boundary of an expanding plasma sheet following substorms. Single sheets of field-aligned currents on this boundary tend to flow toward the earth in the morning quadrant and away in the evening. Multiple sheets of current may also occur, with the direction of the high latitude sheet generally being the same as for a single sheet. A second type of field change is a decrease in field inclination during substorms. This is regarded as a manifestation of the changing field configuration during substorms and can be described in terms of azimuthal currents. Author

N72-29431# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Hydraulics and Water Resources.
TSUNAMIS: A MODEL OF THEIR GENERATION AND PROPAGATION
Joseph Leonard Hammack, Jr. Jun. 1972 273 p refs
(Grants NSF GK-2370; NSF GK-24716)
(KH-R-28) Avail: NTIS HC $15.75

A general solution is presented for water waves generated by an arbitrary movement of the bed (in space and time) in a two-dimensional fluid domain with a uniform depth. The integral solution is based on a linearized approximation to the complete (nonlinear) set of governing equations. The general solution is evaluated for the specific case of a uniform upthrust or downthrow of a block section of the bed; two time-displacement histories of the bed movement are considered. An integral solution (based on a linear theory) is also developed for a three-dimensional fluid domain of uniform depth for a class of bed movements which are axially symmetric. An experimental program was conducted to confirm both the linear model for the two-dimensional fluid domain and the strategy suggested for determining wave profiles during propagation after the linear theory becomes invalid. The linear theory is found to accurately approximate the wave behavior in the region of generation whenever the total displacement of the bed is much less than the water depth. Author

N72-29432*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIELECTRIC CONSTANTS OF SOILS AT MICROWAVE FREQUENCIES
F. E. Geiger and Donald Williams Apr. 1972 34 p refs
(NASA-TM-X-65987; X-652-72-283) Avail: NTIS HC $3.75 CSCL 08M

A knowledge of the complex dielectric constant of soils is essential in the interpretation of microwave airborne radiometer data of the earth's surface. Measurements were made at 37 GHz on various soils from the Phoenix, Ariz., area. Extensive data have been obtained for dry soil and soil with water content in the range from 0.6 to 35 percent by dry weight. Measurements were made in a two arm microwave bridge and results were corrected for reflections at the sample interfaces by solution of the parallel dielectric plate problem. The maximum dielectric constants are about a factor of 3 lower than those reported for similar soils at X-band frequencies. Author

N72-29433# Bureau of Mines, Denver, Colo. Mining Research Center.
IN SITU DETERMINATION OF STRESSES IN MOUNTAINOUS TOPOGRAPHY
Verne E. Hooker, David L. Bickel, and James R. Aggson 1972 23 p refs
(BM-RI-7654) Avail: NTIS HC $3.25

Stress relief measurements were made at three underground test sites associated with the Henderson project, American Metal Climax, located in the rugged, mountainous region between Loveland Pass and Berthoud Pass on the Continental Divide in Colorado. Sufficient data were obtained to determine the three-dimensional stress ellipsoid for each site. The measurements were made at hole depths greater than one diameter of the mined opening; thus, calculated stresses are representative of premining in situ conditions. The vertical components of stress are in good agreement with overburden depth including the influence of mountain topography. Horizontal components of stress substantially increase with depth. These components are believed to be influenced by stresses presumably of tectonic origin. The largest measured principal stress was 5900 psi at a depth of 3708 feet. The predominant orientation of maximum principal stress for the determinations at greatest depth is in the NW-SE quadrants. Author

N72-29434*# Scientific Translation Service, Santa Barbara, Calif.
TEMPERATURE CHANGES IN THE GROUND
Oskar Reya Washington NASA Aug. 1972 11 p Transl. into ENGLISH from Drustvo Meteorologov Slovenije, Meteoroloski Zbornik (Yugoslavia), no. 1, 1957 p 92-100
(Contract NASw-2035)
(NASA-TT-F-14502) Avail: NTIS HC $3.00 CSCL 08M

The temperature changes in the ground at Ljubljana are discussed. These changes are observed to a depth of 50 cm in the months of April through October. Author

N72-29435*# National Meteorological Center, Suitland, Md.
RESULTS OF A ROCKET-NIMBUS SOUNDER COMPARISON EXPERIMENT
Alvin J. Miller and Frederick G. Finger Jun. 1972 30 p refs
(NASA Order P-48606(G))
(NASA-CR-62081) Avail: NTIS HC $3.50 CSCL 04A

Stratospheric temperature data obtained from instrumentation on board Nimbus 3 and 4 are compared with conventional rocket soundings to determine the compatibility of measurements. The Arcasonde 1A and Datasonde were the primary rocketsondes used, but acoustic grenade and pitot probe soundings were also involved. Observed temperature profiles and computed radiances obtained from rocket soundings are compared with 15-microns data provided by the satellite infrared spectrometers, the infrared interferometer spectrometer, and the selective chopper radiometer onboard the satellites. A reasonable agreement between the rocket and satellite data is indicated, but variations are noted which are related to the sounding techniques. Author

N72-29436# European Space Research Inst., Frascati (Italy).
ON THE ORIGIN OF SMALL-SCALE TYPE 2 IRREGULARITIES IN THE EQUATORIAL ELECTROJET
Andre Rogister and Nicola DAngelo [1972] 5 p refs

Submitted for publication
Avail: NTIS HC $3.00

The order of magnitude is estimated for the largest wave number at which suprathermal fluctuation levels can be nonlinearly excited by the crossed field instability in the equatorial electrojet. ESRO

N72-29437# Kiruna Geophysical Observatory (Sweden).
FIELD ALIGNED ELECTRON ANISOTROPIES OBSERVED BY THE ESRO 1A (AURORAE) SATELLITE
Lars-Aake Holmgren and Bruno Aparicio May 1972 16 p refs Presented at the 15th COSPAR Meeting, Madrid, 1972 Sponsored in part by Swed. Nat. Sci. Res. Council, Swed. Board for Tech. Develop., and IAEA
(KGO-Preprint-72-302) Avail: NTIS HC $3.00

Field aligned electron anisotropies have been observed at high latitudes for energies 1 and 6 keV with a typical frequency of occurrence of 1% to 3% and in some rare cases also at 13 keV. It is found that angular distributions with maxima along the geomagnetic field lines occur most frequently at lower energies. The occurrence frequency increases with increasing Kp. Two major regions of maximum occurrence frequency have been found. One is located in the evening to midnight local magnetic time sector closely poleward of the experimentally defined limit of stably trapped electrons E greater than 40 keV. The second region, identified as the dayside low altitude polar cusp, shows a maximum in occurrence frequency in the noon to evening sector. For Kp = 1 sub + - 3 sub 0 another region is found to auroral zone latitudes in the morning-noon sector. The relation of these anisotropies to previously reported field aligned positive ion anisotropies is briefly discussed. Author (ESRO)

N72-29438# Kiruna Geophysical Observatory (Sweden).
STUDIES OF STORM EFFECTS ON THE TOTAL ELECTRON CONTENT AND OF IONOSPHERIC IRREGULARITIES BY MEANS OF IMPROVED TECHNIQUES
Sixten Olsson Apr. 1972 125 p refs Sponsored by Swed. Nat. Sci. Res. Council
(KGO-725) Avail: NTIS HC $8.25

A number of newly developed devices for ionsospheric measurements are described using digital techniques with integrated circuits, made possible by a new way of achieving complete noise suppression when recording radio wave pulses reflected from the ionosphere. They include: an ionosonde receiver with automatic noise suppression and digital-analog recording of the first ionospheric reflection, fixed frequency ionosonde receiver with a phase swept interferometer, and a Titheridge type polarimeter. Some results obtained from Intelsat LF-1 polarimeter are reported. The methods for generation and detection of artifical atmospheric waves by a supersonic aircraft are presented. ESRO

N72-29439# Institut Royal Meteorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS Monthly Bulletin, Jul. 1971 [OBSERVATIONS GEOPHYSIQUES BULLETIN MENSUEL, JUILLET 1971]
Jul. 1971 28 p In FRENCH and DUTCH
Avail: NTIS HC $3.50

Geophysical data are presented from Dourbes (Belgium). Geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during July 1971 are discussed. ESRO

N72-29440# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
PLASMA CHARACTERISTICS NEAR THE BOUNDARY OF THE MAGNETOSPHERE
I. M. Podgorny, Y. V. Andrianov, and E. M. Dubinin May 1972 24 p refs Presented at the 15th COSPAR Meeting, Madrid, 1972
(D-130) Avail: NTIS HC $3.25

Fluctuations of electric and magnetic fields in the region between the front of the shock wave and the magnetosphere boundary were studied. It was previously shown that there is a clear analogy between the processes occuring the collisionless shock wave in outer space and in the laboratory. The energy dissipation of the directed plasma motion in the shock wave is due to fluctuations of magnetic and electric fields. The fluctuations of the electric field in the region of frequences close to a hybrid one arise at the stage of wave formation. The distribution of potential shows that two-flux instability may be the cause of electric fluctuations. The spectrum of microfluctuations is given; their spatial distribution is studied. The fluctuations are concentrated in the region of the shock wave. They are practically absent in the artificial solar wind and inside the artificial magnetosphere. Author (ESRO)

N72-29441# European Space Research Organization, Paris (France).
PARTICLE AND AURORAL OBSERVATIONS FROM THE ESRO 1/AURORAE SATELLITE
C. S. Deehr, Comp., R. J. Davidson, Ed., and A. Egeland, Ed. Jun. 1972 59 p refs Sponsored in part by Roy. Norweg. Council for Sci. and Ind. Res., UK Sci. Res. Council, and Swed. Nat. Sci. Res. Council
(ESRO-SR-20) Avail: NTIS HC $5.00

The main aims of the eight experiments onboard the ESRO 1/Aurorae satellite, launched in October 1968, were the study of the fine structure of the auroras and correlation studies between auroral particles and luminosity, along with ionospheric composition and heating effects. This investigation concentrated on three series of three orbits each, each series representing a different level of geomagnetic activity. The data were restricted to the 55 to 85 deg N invariant latitude region, near geomagnetic midnight, and within the Tromso ground station, which was capable of recording high speed, real time, telemetry data. Author (ESRO)

N72-29442# Institut Royal Meteorologique de Belgique, Brussels.
IONOSPHERIC AND COSMIC RAY OBSERVATIONS Monthly Bulletin, Nov. 1971 [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE BULLETIN MENSUEL, NOVEMBRE 1971]
Nov. 1971 31 p In FRENCH and DUTCH
Avail: NTIS HC $3.75

Results of ionospheric and cosmic ray (neutron component) observations at Dourbes (Belgium) are tabulated for November 1971. ESRO

N72-29443# Institut Royal Meteorologique de Belgique, Brussels.
IONOSPHERIC AND COSMIC RAY OBSERVATIONS Monthly Bulletin, Dec. 1971 [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE BULLETIN MENSUEL, DECEMBRE 1971]
Dec. 1971 31 p In FRENCH and DUTCH
Avail: NTIS HC $3.75

Results of ionospheric and cosmic ray (neutron component) observations at Dourbes (Belgium) are tabulated for December 1971. ESRO

N72-29444# Naval Research Lab., Washington, D.C. Plasma Dynamics Branch.
OPTICAL AND INFRARED EMISSION FROM DISTURBED E AND F LAYERS. PART 1: THEORETICAL CONSIDERATIONS
A. W. Ali Apr. 1972 18 p refs
(AD-740743; NRL-MR-2404-Pt-1) Avail: NTIS CSCL 04/1

A general discussion of possible optical and infrared sources of radiation from disturbed E and F regions is given. Radiation from relevant atmospheric species present in the UV-fireball is emphasized. Author (GRA)

N72-29445# Space Data Corp., Phoenix, Ariz.
SOLID FUEL GASEOUS OXYGEN REACTION TECHNIQUES FOR PRODUCING HIGH ALTITUDE BARIUM VAPOR CLOUDS Final Technical Report, 15 Apr. 1970 - 30 Nov. 1971
Edward F. Allen, Jr. and Philip E. Beaudoin Jan. 1972 26 p refs
(Contract F30602-71-C-0041; ARPA Order-1057)
(AD-740509; RADC-TR-72-36) Avail: NTIS CSCL 04/1

The program was conducted to develop superior techniques for producing barium vapor clouds at high altitudes using sounding rockets. Several possible vapor production reactions are considered and thermochemical computations are performed comparing achievable efficiencies of yielding free barium at high temperatures. Several prime candidate reactions are evaluated for safety in use and practicality in reactor design. A reactor has been designed for future implementation. Thermochemical computations, ground test results and preliminary flight test observations indicate a large increase in vaporization efficiency over previously used reactions. Author (GRA)

N72-29446# Teledyne Geotechnical, Alexandria, Va. Seismic Data Lab.
SINGLE STATION AND ARRAY METHODS FOR IMPROVED SURFACE WAVE SPECTRAL ESTIMATES
John W. Lambert and S. S. Alexander 13 Dec. 1971 107 p
(Contract F33657-72-C-0009; ARPA Order 1714)
(AD-740427; SDL-264) Avail: NTIS CSCL 17/10

Combined matched filtering and array summing methods have been developed that yield improved spectral estimates for weak surface waves. Both theoretically and experimentally the best spectral estimates are obtained by first beaming an array of individual matched filtered seismograms and then computing a single noise-corrected spectrum. Spectral results for test cases and actual events are compared using three different techniques. Computer programs implementing these spectral methods have been written which are suitable for routinely processing many events. Author (GRA)

N72-29447# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
ION COLLECTION BY A POSITIVE ION MASS SPECTROMETER
Christopher Sherman 21 Jan. 1972 20 p refs
(AF Proj. 6687)
(AD-740857; AFCRL-72-0038) Avail: NTIS CSCL 04/1

Measurements of the voltage-current ion-collection characteristics of a rocket-borne quadrupole mass spectrometer are reported and compared with those previously obtained by means of numerical calculation. Author (GRA)

N72-29448# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
SUPERSONIC AND SUBSONIC MEASUREMENT OF MESOSPHERIC IONIZATION
Larry Nickell 1 Nov. 1971 31 p refs
(Grants DA-ARO(D)-31-124-71-G110; NSF GZ-1708)
(AD-740177; PSU-IRL-SCI-377; AROD-7430-5-E) Avail: NTIS CSCL 04/1

An Arcas rocket-parachute system was used at night to compare supersonic and subsonic ionization measurements below 75 km. A hemispherical nose-tip probe was used on ascent and a parachute-born blunt probe was employed on descent to measure polar conductivities, which were due entirely to positive and negative ions. Author (GRA)

N72-29449# Mainz Univ. (West Germany).
RESEARCH ON ATMOSPHERIC OPTICAL RADIATION TRANSMISSION Final Scientific Report, 1 Jan. - 31 Dec. 1971
Elisabeth deBary, Kurt Bullrich, Reiner Eiden, Guenter Eschelbach, and Gottfried Haenel Feb. 1972 77 p refs
(Contract F61052-69-C-0016; AF Proj. 7621)
(AD-740871; AFCRL-72-0180) Avail: NTIS CSCL 04/1

To assess the contribution of particulate pollutants to radiative processes and radiative transfer, it is necessary to know the radiation characteristics of natural and anthropogenious particles. The report describes the number and the size of the atmospheric aerosol particles and the possibilities to evaluate them by optical methods. Theoretical results of the influence of absorbent aerosol particles on the energy balance of the atmosphere in the visible wavelength range are also discussed. Some measurement results are given of spectral solar extinction and sky radiances. Finally, a survey is presented of new experimental results of some fundamental parameters of atmospheric aerosol particles such as density, refractive index, extinction coefficient, volume - and mass change as a function of the relative humidity of the air. GRA

N72-29450# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
SOME PROBLEMS IN STRENGTHENING THAWING SOILS IN IGARKA AND NORILSK
V. F. Zhukov 1972 7 p refs Transl. into ENGLISH from Tr. Igarskaya Nachn.-Issled. Merzlotnaya Stantsiya (USSR), no. 2, 1961 p 70-72
(AD-741058; CRREL-TL333) Avail: NTIS CSCL 08/13

The frozen soils of Igarka, represented chiefly by loams, are typified by great iciness and a clearly expressed cryogenic texture. Analogous Noril'sk soils which are used as footings under the foundations of apartment buildings and industrial structures also contain ice. Reference is often made by the opponents of the pre-construction of the thawed soils to the liquefaction of frozen soils after thawing. It is known that the thawing of frozen soils in the base of foundations is associated with risk of the foundations' subsidence and the deformation of the structure, therefore it is feasible to arrange a timely (prior to erection of the structure) thawing and strengthening of the very icy soils in order that subsequently, their compressibility under the foundations would be slight and within tolerable limits.

Author (GRA)

N72-29451# TRW Systems Group, Redondo Beach, Calif. Theoretical Physics Group.
ANALYTICAL STUDIES OF SCATTERING AND EMISSION BY THE SEA SURFACE Final Report, 1 Mar. 1971 - 1 Mar. 1972
Richard J. Wagner and Philip J. Lynch Mar. 1972 72 p refs
(Contract N00014-71-C-0240; NR Proj. 387-051)
(AD-740237; TRW-17608-6006-R0-00) Avail: NTIS CSCL 08/3

Geometrical optics theories of scattering, transmission, and emission of electromagnetic radiation from two-dimensional, anisotropic, randomly rough surfaces have been formulated which explicitly include the effects of surface shadowing and double scatter. These theoretical developments, which have been fully documented in technical reports issued on this contract, are herein summarized in abstract form. Application of the emission and scattering theories to the modeling of sea brightness temperatures is discussed. The equations for the sea brightness temperature are numerically evaluated for microwave frequencies and the results compared with those of earlier models of Stogryn and of Wagner and Lynch. The second-order contributions, which prove to be appreciable, are examined in detail as a function of surface roughness, observation direction, and polarization. The quantitative dependence of the sea brightness temperature on frequency, polarization, observation angle, wind speed, fetch direction, atmospheric state, surface contamination, and water temperature is illustrated. The wavelength dependence of the emissivity of small-scale surface structure is examined using nongeometrical optics methods. Author (GRA)

N72-29452# Aeronautical Chart and Information Center, St. Louis, Mo. Technical Translation Section.
ON LARGE SCALE AEROPHOTO-TOPOGRAPHIC SURVEY

OF BUILT UP AREAS
N. A. Sokolova Apr. 1972 16 p Transl. into ENGLISH from Geodeziya: Kartografiya (USSR), no. 10, 1971 p 41-47
(AD-741063; ACIC-TC-1825) Avail: NTIS CSCL 08/2

The paper deals with an inexpensive means of producing the planimetric part of a map. This process is called 'photomap'. The problem of producing photomaps of built-up areas must be solved by means of a suitable selection of aerial cameras and scale of photography. The report gives directions for plotting details from photographs by use of a stereoplotter.

Author (GRA)

N72-29453# Boston Coll., Chestnut Hill, Mass. Space Data Analysis Lab.
CYLINDRICAL LANGMUIR PROBE MEASUREMENTS FROM NIROS ROCKETS Final Report, 1 Nov. 1968 - 31 Oct. 1971
Robert C. Wilson 30 Nov. 1971 97 p refs
(Contract F19628-69-C-0012; AF Proj. 7663)
(AD-741798; AFCRL-72-0118) Avail: NTIS CSCL 04/1

The current measurements made by cylindrical Langmuir probe systems flown on NIRO vehicles are described. Particular emphasis is placed on the electron current and the positive ion current. Measurements were made over an altitude range extending from 60 kilometers to 145 kilometers, thus encompassing the D- and E-regions. The development of the electronic instrumentation is presented. Author (GRA)

N72-29454# Aeronautical Chart and Information Center, St. Louis, Mo. Technical Translation Section.
ON SPECIALIZATION OF MAP COMPILATION WORK
D. A. Larin Apr. 1972 10 p Transl. into ENGLISH from Geodeziya i Kartografiya (USSR), no. 10, 1971 p 61-64
(AD-741862; ACIC-TC-1826) Avail: NTIS CSCL 08/2

The paper is a critical answer to a paper 'Specialization of production in the cartographic industry'. The author of the present paper tells where he agrees with the author of the original paper in suggesting that the printing of certain types of maps and atlases should be done in specialized enterprise. However, he takes the original author to task for not doing enough research work to corroborate his statements. The author of this paper gives his own views regarding the organization of a scientific-production institute. Author (GRA)

N72-29455# Technischen Universitaet, Munich (West Germany).
SIMULTANEOUS MEASUREMENTS OF ELF-ATMOSPHERICS BY SEPARATE STATIONS Final Scientific Report, 1 Apr. 1970 - 31 Mar. 1972
Herbert L. Koenig 1 Apr. 1972 13 p refs
(Contract F61052-70-C-0032; AF Proj. 5631)
(AD-742326; Rept-0032/1; AFCRL-72-0240) Avail: NTIS CSCL 04/1

The present research program has been carried out to obtain more detailed information about the propagation phenomena and the origin of ELF-waves in the frequency range of the Schumann-resonances, i.e. between 4 Hz and 24 Hz. Therefore, simultaneous measurements of both the magnetic and the electric fields have been performed by two almost identically equipped stations. One station is located near Kingston, R.I., U.S.A., and supervised by members of the University of Rhode Island, the other, operated by the author, is situated in Brannenburg/Munich, W-Germany. The results of these cooperative investigations will permit prediction of the state of the lower ionosphere and some types of solar events.

Author (GRA)

N72-29456# American Science and Engineering, Inc., Cambridge, Mass.
ANALYSIS OF SATELLITE DATA Final Report, 1 Mar. 1967 - 28 Feb. 1972
Daniel R. Parsignault and Richard C. Chase 31 Mar. 1972 47 p refs
(Contract F19628-67-C-0277; AF Proj. 8600)
(AD-742328; ASE-2927; AFCRL-72-0219) Avail: NTIS CSCL 04/1

A resume is given of the data analyzed from the Hitch-Hiker 1, the OV1-9, and the OV1-13 satellites. The theoretical work done on the characteristics of the electrostatic analyzer, and of a model of the earth's radiation belts developed as a result of satellite data is included. The data analysis pertained to (a) electron data with $E < 0.7$ MeV in the outer radiation belt of the earth's magnetosphere, (b) electron and proton data with $10 < \text{or} = E < \text{or} = 50$ keV, in the inner radiation belts, and (c) low energy proton data with $0.08 < \text{or} = E < \text{or} = 5$ MeV in the outer radiation belt. The bulk of data given deals with (c).

Author

N72-29457# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
THE APPLICATION OF THE COMBINED WAVE INTERACTION SPACED RECEIVER TECHNIQUE TO D REGION WINDS
Jeffrey S. Schleher 14 Feb. 1972 97 p refs
(Contract N00014-67-A-0385-0014; Grant NSF GA-13885)
(AD-742125; PSU-IRL-SCI-388; SR-388) Avail: NTIS CSCL 04/1

The purpose of this study is to examine the possibility of combining the spaced receiver and wave interaction techniques to examine wind structure in the D-region of the ionosphere.

GRA

N72-29458# Philco-Ford Corp., Billings, Mont. Communications and Technical Services Div.
MONTANA LARGE APERTURE SEISMIC ARRAY Quarterly Technical Report, 1 Dec. 1971 - 29 Feb. 1972
Robert E. Matkins 15 Mar. 1972 78 p refs
(Contract F33657-72-C-0390; ARPA Order 1620)
(AD-742488; TR-2056-72-16; QTR-1) Avail: NTIS CSCL 17/10

The technical activity associated with the operation, maintenance, and improvement of the Montana Large Aperture Seismic Array (LASA) during the period 1 December 1971 - 29 February 1972 is related in this report. The short-period (SP) and long-period (LP) seismograph sensitivity performance statistics are indicated. Elimination of the microbarograph data from the sensors in the B-, C- and D-ring subarrays is reported. Performance of the SP seismograph calibration oscillators is discussed. A new PDP-7 program for remote measurement of RA-5 amplifier gain and SP seismometer output is described.

Author (GRA)

N72-29459# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
AFCRL SPACE SCIENCE RESEARCH DURING 1971. ANNUAL AFCRL REPORT TO THE SPACE SCIENCE BOARD OF THE NATIONAL ACADEMY OF SCIENCES FOR SUBMISSION TO COSPAR Special Report No. 130, 1 Jan. - 31 Dec. 1971
A. McIntyre, ed. and C. D. Howard, ed. 17 Jan. 1972 39 p
(AD-741757; AFCRL-72-0056) Avail: NTIS CSCL 04/1

A summary of the space science activities of the Air Force Cambridge Research Laboratories (AFCRL) in 1971, including rockets, satellites, and balloons launched, results of experiments associated with the measurement and study of energetic particles and magnetic fields, upper atmosphere physics, ionospheric physics, geodesy, and optical physics, and experiments planned for 1972, are included. The definition of space science for the purpose of this report is limited to in-situ observations and measurements using the broad definition of space.

Author (GRA)

N72-29460# Air Force Weapons Lab., Kirtland AFB, N.Mex.
POLARIZATION OF INFRARED WAVES CAUSED BY PROPAGATION THROUGH THE ATMOSPHERE Technical

Report, Aug. 1971 - Mar. 1972
J. Philip Castillo Apr. 1972 233 p refs
(AF Proj. 5791)
(AD-741878; AFWL-TR-72-53) Avail: NTIS CSCL 04/1

The study presents an investigation of the polarization of infra-red waves due to propagation through the atmosphere. Cumulus cloud and Haze M particle size distributions are considered for various optical depths at wavelengths of 4.0 and 10.0 micrometers. Results at these wavelengths are compared to results at a wavelength of 0.5 micrometers for the same physical atmosphere. Initially the radiative transfer integral equations are derived which include the Stokes polarization vector. From these integral equations a Monte Carlo simulation technique is used to photon histories through the atmosphere. The effects of multiple scattering on the polarization state of the scattered intensity is included. A diffuse scattering ground which causes complete depolarization of the incident intensity is included in the simulation model. Author (GRA)

N72-29461# TRW Systems Group, Redondo Beach, Calif.
EMISSION AND REFLECTION FROM ANISOTROPIC RANDOM ROUGH SURFACES
Philip J. Lynch and Richard J. Wagner Mar. 1972 68 p refs
(Contract N00014-71-C-0240; NR Proj. 387-051)
(AD-741705; TRW-17608-6005-R0-00) Avail: NTIS CSCL 08/10

A geometrical-optics theory of emission and scattering from anisotropic random rough surfaces is developed. A complete ray treatment is provided in the sense that multiple-scatter and bistatic shadowing effects are included in a consistent manner for a general two-dimensionally rough surface. It is also shown that, in the context of this theory, both upper and lower bounds exist to the effects of surface roughness on the emissivity. A numerical calculation of the emissivity for a perfect conductor provides a check on the theory against a known result, and the scattering theory is shown to conserve energy to a relatively high degree of approximation when double-scatter effects are included. Predictions of the emission theory for the thermal microwave emission from the sea surface are compared with the results of earlier theories. Author (GRA)

N72-29462# Teledyne Industries, Inc., Alexandria, Va.
OPERATION OF THE TONTO SEISMOLOGICAL OBSERVATORY Quarterly Report, 1 Jan. - 31 Mar. 1972
B. B. Leichliter 15 Apr. 1972 22 p
(Contract F33657-72-C-0013; ARPA Order 1714)
(AD-742476; TR-72-4; QR-3) Avail: NTIS CSCL 17/10

The report is of the work accomplished on Project VT/2704 from 1 January through 31 March 1972. It describes the operation, evaluation, and improvement of the Tonto Forest Seismological Observatory (TFSO) located near Payson, Arizona, research and test functions carried out at the TFSO, and research and development tasks performed by the Garland, Texas, staff using TFSO data. Author (GRA)

N72-29463# R and D Associates, Santa Monica, Calif.
THE CHEMISTRY OF NITROGEN OXIDES AND OZONE IN THE DISTURBED D-REGION
H. A. Ory and F. R. Gilmore Sep. 1971 27 p refs
(Contract DASA01-71-C-0103)
(AD-741707; DNA-2835T; RDA-TR-017-DNA) Avail: NTIS CSVL 04/1

Chemical kinetic calculations are presented which describe the chemistry of nitrogen oxides and ozone in D-region air bombarded by an intense pulse of X-rays as would be produced by nuclear explosions. Relatively latetime behavior is emphasized; early deionization processes are treated in a summary fashion. Special attention is given to the reactions of excited species, which have not been included previously, but which greatly affect the yields of NO, NO2, and O3. Results are given for various altitudes, bombardment intensities, and both day and night conditions. The reactions that mainly control the chemistry are identified, and the effects of the excited species are summarized. Author (GRA)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N72-29464* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPARATUS FOR IONIZATION ANALYSIS Patent
Vladimir Zaviantseff, inventor (to NASA) Issued 11 Jul. 1972 6 p Filed 16 Jul. 1970 Supersedes N70-34558 (18 - 14, p 3354) Sponsored by NASA
(NASA-Case-ARC-10017-1; US-Patent-3,676,674; US-Patent-Appl-SN-55536; US-Patent-Class-250-71.5R; US-Patent-Class-250-41.9D; US-Patent-Class-313-356) Avail: US Patent Office CSCL 14B

An apparatus for ionization analysis is described. The device consists of a generally concentric outer and inner tubular shaped electrodes between which a dc potential is applied so as to produce an electric field. Adjacent scintillating and photoemissive members are mounted inside the inner electrode, and generally aligned front and rear apertures are formed in the electrodes. Positive ions from a source of ions are directed through the front apertures and onto the scintillating member for the production of light pulses. The photoemissive member produces photoelectrons which are directed outwardly from the electrodes through the rear apertures. The dc potential which produces the electric field functions to accelerate both the incident positive ion beam and the photoelectrons produced by the photoemissive member.
Official Gazette of the U.S. Patent Office

N72-29465*# American Science and Engineering, Inc., Cambridge, Mass.
RESEARCH STUDY ON STELLAR X-RAY IMAGING EXPERIMENT, VOLUME 1 Final Report, 12 Jun. 1969 - 31 Mar. 1972
Henry H. Wilson and Leon P. VanSpeybroeck 15 May 1972 100 p 2 Vol.
(Contract NAS8-24385)
(NASA-CR-123743; ASE-2978-Vol-1) Avail: NTIS HC $7.00 CSCL 14B

The use of microchannel plates as focal plane readout devices and the evaluation of mirrors for X-ray telescopes applied to stellar X-ray imaging is discussed. The microchannel plate outputs were either imaged on a phosphor screen which was viewed by a low light level vidicon or on a wire array which was read out by digitally processing the output of a charge division network attached to the wires. A service life test which was conducted on two image intensifiers is described. Author

N72-29466*# American Science and Engineering, Inc., Cambridge, Mass.
RESEARCH STUDY ON STELLAR X-RAY IMAGING EXPERIMENT, VOLUME 2 Final Report, 12 Jun. 1969 - 31 Mar. 1972
Henry H. Wilson and Leon P. VanSpeybroeck 15 May 1972 131 p 2 Vol.
(Contract NAS8-24385)
(NASA-CR-127688; ASE-2978-Vol-2) Avail: NTIS HC $8.75 CSCL 14B

A review of the scientific objectives of an integrated X-ray orbiting telescope facility is presented. A set of observations to be conducted to achieve the objectives of the research are described. The techniques and equipment used in the experiment are defined. The configuration of the facility and the specifications of the test equipment are included. Author

N72-29467*# Barringer Research Ltd., Rexdale (Ontario).
RECENT PROGRESS IN THE REMOTE DETECTION OF VAPOURS AND GASEOUS POLLUTANTS
A. J. Moffat and A. R. Barringer [1971] 35 p refs Sponsored in part by NASA
(NASA-CR-127632) Avail: NTIS HC $3.75 CSCL 14B

Work has been continuing on the correlation spectrometry techniques described at previous remote sensing symposiums. Advances in the techniques are described which enable accurate quantitative measurements of diffused atmospheric gases to be made using controlled light sources, accurate quantitative measurements of gas clouds relative to background using solar illumination and semi-quantitation measurements of well diffused atmospheric gases using solar illumination. Specific applications of these techniques are described including preliminary results of a high altitude balloon experiment designed to test the feasibility of measuring pollution at the earth's surface from high altitude balloons and satellites. Author

N72-29468*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PRECISE LINEAR SUN SENSOR
Danny D. Johnston 9 Jun. 1972 53 p
(NASA-TM-X-64649) Avail: NTIS HC $4.75 CSCL 14B

An evaluation of the precise linear sun sensor relating to future mission applications was performed. The test procedures, data, and results of the dual-axis, solid-state system are included. Brief descriptions of the sensing head and of the system's operational characteristics are presented. A unique feature of the system is that multiple sensor heads with various fields of view may be used with the same electronics. Author

N72-29469*# TRW Systems, Redondo Beach, Calif.
MULTIWIRE PROPORTIONAL COUNTER DEVELOPMENT Quarterly Progress Report
31 Jan. 1972 14 p
(Contract NAS9-11315)
(NASA-CR-115732) Avail: NTIS HC $3.00 CSCL 14B

A test run was made at the Bevatron to check the character of signals induced in an electromagnetic delay line capacitively coupled to the wire cathode plane of a multiwire proportional chamber. In particular, these signals and the behavior of the readout electronics as a function of associated delta-ray production are studied. These measurements are important in assessing the effect of delta-ray background on the spatial resolution attainable for the primary ions. Test results are used to design a multiwire proportional chamber and readout system for use as spatial detectors in a superconducting magnetic spectrometer experiment. Author

N72-29470# Hoverproducts Ltd., Ottawa (Ontario).
CARSP: EXPLORATORY SYSTEMS STUDY INVESTIGATING THE SUITABILITY OF AEROSTATS FOR REMOTE SENSING PLATFORM APPLICATIONS
Leonard X. Pomerlean 20 Nov. 1970 165 p Sponsored by Geol. Survey of Canada
(HPL Proj. H-038-1)
Avail: NTIS HC $10.25

Remote sensing denotes an activity performed by a system: a combination of men, material and techniques operating in concert and having a specific function. One of the major components of such a system is the platform which supports the sensor instrumentation at a vantage height above the planet surface. In this study, it is demonstrated that self-propelled aerostats capable of controlled flight and station keeping at various elevation can be designed and that these show many advantages over other types of platforms which are presently being considered for use or which are being used in remote sensing operations. Author

N72-29471*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ANALYTICAL DESIGN OF SENSORS FOR MEASURING ATOMOSPHERIC TEMPERATURE DURING TERMINAL PHASE OF PLANETARY ENTRY
John P. Millard, Michael J. Green, and Simon C. Sommer Washington Aug. 1972 28 p refs
(117-07-04-14)
(NASA-TN-D-6947; A-4412) Avail: NTIS HC $3.00 CSCL 14B

An analytical study was conducted to develop a sensor for measuring the temperature of a planetary atmosphere from an entry vehicle traveling at supersonic speeds and having a detached shock. Such a sensor has been used in the Planetary Atmosphere Experiments Test Probe (PAET) mission and is planned for the Viking-Mars mission. The study specifically considered butt-welded thermocouple sensors stretched between two support posts; however, the factors considered are sufficiently general to apply to other sensors as well. This study included: (1) an investigation of the relation between sensor-measured temperature and free-stream conditions; (2) an evaluation of the effects of extraneous sources of heat; (3) the development of a computer program for evaluating sensor response during entry; and (4) a parametric study of sensor design characteristics. Author

N72-29472# American National Standards Inst., New York.
RADIATION SAFETY FOR X-RAY DIFFRACTION AND FLUORESCENCE ANALYSIS EQUIPMENT
Jun. 1972 21 p refs
(NBS-Handbook-111; LC-71-189153) Avail: SOD $0.30 as C 13.11:111

The types of injuries resulting from accidental exposure to ionizing radiation resulting from the operation of X-ray diffraction and fluorescence analysis equipment are reviewed, equipment design criteria are established, requirements from approved operating procedures are set up and the establishment of health surveillance, and personnel monitoring program are recommended. The circumstances under which operation of equipment must be limited to specially designated areas equipped with radiation barriers and warning signs are set forth. Maximum permissible dose limits established are stated. A list of references to selected articles on various aspects of radiation safety is given and notes on the detection and measurement of radiation from X-ray diffraction and fluorescence analysis equipment are included in an appendix. Author

N72-29473*# National Bureau of Standards, Washington, D.C. Heat Div.
FUNDAMENTAL PRINCIPLES OF ABSOLUTE RADIOMETRY AND THE PHILOSOPHY OF THIS NBS PROGRAM (1968 TO 1971)
Jon Geist Jun. 1972 63 p refs
(NASA Order C-41584-B)
(NASA-CR-127780; NBS-TN-594-1) Avail: NTIS; SOD $0.60 as C13.46:594-1 CSCL 14B

A description is given work performed on a program to develop an electrically calibrated detector (also called absolute radiometer, absolute detector, and electrically calibrated radiometer) that could be used to realize, maintain, and transfer a scale of total irradiance. The program includes a comprehensive investigation of the theoretical basis of absolute detector radiometry, as well as the design and construction of a number of detectors. A theoretical analysis of the sources of error is also included. Author

N72-29474*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
EXTREME ULTRAVIOLET AND X-RAY SPECTROHELIOGRAPH FOR OSO-H Final Report, 1968 - Sep. 1971
A. A. Sterk, F. Kieser, S. Peck, and E. Knox 20 Jan. 1972 205 p
(Contract NAS5-11169)
(NASA-CR-122502; DIN-71SD4268) Avail: NTIS HC $12.25 CSCL 14B

A complex scientific instrument was designed, fabricated, tested, and calibrated for launch onboard OSO-H. This

instrument consisted of four spectroheliographs and an X-ray polarimeter. The instrument is designed to study solar radiation at selected wavelengths in the X-ray and the extreme ultraviolet ranges, make observations at the H-alpha wavelength, and measure the degree of polarization of X-ray emissions. Author

N72-29475# Sandia Labs., Albuquerque, N.Mex.
MOTION SENSOR DEVELOPMENT
J. K. S. Walter Mar. 1972 63 p refs Sponsored by AEC
(SC-DR-710910) Avail: NTIS

Results are recorded of design and development effort expended on prototype motion sensors. As presently defined, the device is primarily a laterally sensitive acceleration/displacement sensor designed to detect displacements at low levels of acceleration. The mechanism is essentially a low (less than 1 cps) natural frequency lateral spring mass system that is acceleration sensitive at very low frequencies and displacement sensitive at high frequencies. Experiments have shown that a sensitivity as low as 0.001 g is feasible. Author

N72-29476# National Physical Lab., Teddington (England). Div. of Quantum Metrology.
DEVELOPMENT OF A CRYOGENIC JOSEPHSON VOLT APPARATUS
J. C. Gallop Apr. 1972 29 p refs
(NPL-QU-22) Avail: NTIS HC $3.50

Experiments utilizing the ac Josephson effect already provide a precise means of monitoring the stability of some of the nationally maintained standards of voltage. The advantages to be gained from operating most components of such a system at cryogenic temperatures are described. Possible measuring systems are outlined and progress made towards their realization is reported. This includes the development of a transformer-matched Josephson double-junction galvanometer, mechanical superconducting switches and cryogenic resistors with a very low temperature coefficient of resistance. Author (ESRO)

N72-29477# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
A ROCKET-BORNE INSTRUMENT FOR MEASURING ELECTRIC FIELDS IN THE AURORAL IONOSPHERE
K. Hyyppae May 1972 40 p ref Submitted for publication Sponsored by Swed. Space Res. Comm.
(TRITA-EPP-72-15) Avail: NTIS HC $4.00

The theory of the double probe method of electric field measurements is briefly reviewed, and the requirements an instrument of this type must fulfill are pointed out. A detailed description of an instrument with two pairs of probes is given. Though the main purpose of the instrument is to measure dc fields it can also measure ac fields up to about 100 kHz and perform some plasma-diagnostic measurements. The ac-sensitivity is better than 1-microvolt/(m square root of Hz) and the dc-electric field accuracy, for the component perpendicular to the spin axis, is + or - 3 mV/m in magnitude and + or - 5 deg in direction. Author (ESRO)

N72-29478# Army Engineer Topographic Labs., Fort Belvoir, Va.
AN ELECTRONIC ANGLE MEASURING DEVICE Final Report
William W. Seemuller Jan. 1972 20 p refs
(DA Proj. 4A0-61101-A-91-D)
(AD-741361; ETL-TR-72-1) Avail: NTIS CSCL 14/2

The design, accuracy analysis, and experimental results of an electronic angle-measuring device are presented. Angle measurement is made by counting the cycles of a stable oscillator which is gated on and off by a rotating disk at points determined by the angle being measured. The device is intended to be used as a surveying instrument where its advantages over existing instruments would be high accuracy with low cost and ease of operation. Analysis indicates that precision manufacturing is not needed to achieve high accuracy and that accuracy can be maintained over wide temperature ranges and with considerable wear between moving parts. Experimental results on a breadboard model indicate that precision greater than 2 seconds of arc is possible. The factor most critical to the precision of the device is the disk rotation system. Author (GRA)

N72-29479# Army Materials and Mechanics Research Center, Watertown, Mass.
DESIGN AND OPERATING CHARACTERISTICS OF A SPLIT HOPKINSON PRESSURE BAR APPARATUS
Kenneth D. Robertson, Shun-Chin Chou, and James H. Rainey Nov. 1971 37 p refs
(DA Proj. 1T0-61102-B-32-A)
(AD-741371; AMMRC-TR-71-49) Avail: NTIS CSCL 14/2

A split Hopkinson bar apparatus capable of conducting compressive strain rate tests at rates ranging from 50 to 10 to the 4th power in./in./sec has been designed and assembled. In principle, the apparatus is similar to that first used by Kolsky in 1949. The design of the apparatus is presented in two parts: the stress-generating system, and the stress-determination system. Detailed drawings of major components of the stress-generating system are included. The technique used to analyze test results is presented. A listing of a computer code which incorporates this technique is also included. The code provides a rapid method for computing the one-dimensional response of the sample of interest. Results for 6061-T6 and 1100-0 aluminum, which are in good agreement with those obtained by other investigators, are given as a check case for the system designed. Author (GRA)

N72-29480# Bell Helicopter Co., Fort Worth, Tex.
EVALUATION OF AN ADVANCED INSTRUMENTATION SYSTEM FOR HELICOPTER ROTORS Final Report
Gerald A. Shockey and Thomas H. Bowden Ft. Eustis, Va. Army Air Mobility Res. and Develop. Lab. Feb. 1972 100 p refs
(Contract DAAJ02-70-C-0036; DA Proj. 1F1-62204-A-139)
(AD-740773; BHC-299-099-497; USAAMRDL-TR-71-72) Avail: NTIS CSCL 14/2

A test was conducted on the Bell Helicopter High Accuracy Rotor Test Stand to evaluate a time division multiplexing system for a rotor environment. The test model was a standard UH-1 tail rotor with a 0.1-inch-thick glove wrapped around the surface for the installation of transducers. The objective of this program was to develop and test a method of obtaining numerous channels of transducer information from a rotating system using a small number of slip rings. The system multiplexed the signal in the rotating system and demultiplexed the signal in the stationary system. Aerodynamic data were measured to evaluate the instrumentation system. Comparisons were made between multiplexed and unmultiplexed signals and between measured data and theory. Author (GRA)

N72-29481# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ONE METHOD OF DETERMINING THE FORCE AND COEFFICIENT OF SLIDING FRICTION
V. V. Andronov 29 Feb. 1972 12 p refs Transl. into ENGLISH from Mashinovedenie (USSR), no. 4, 1970 p 104-107
(AD-742420; FTD-HT-23-1370-71) Avail: NTIS CSCL 14/2

A method is analyzed for determining the forces and coefficients of friction based on indirect methods of measurement which does not require the assumption that the forces and coefficient of friction are independent of friction speed. The method is based on the effect of apparent conversion of dry friction to viscous friction. Formulas are concluded which provide a theoretical basis for the experimental determination of the forces of dry friction by this method. The method can be used for either linear or rotating friction. GRA

N72-29482# Army Foreign Science and Technology Center, Charlottesville, Va.
NONLINEAR DEFORMATION OF AERIAL FILM
O. V. Portnova 19 Dec. 1971 10 p refs Transl. into ENGLISH from Geodeziya i Kartografiya (USSR), no. 6, 1971 p 64-68
(AD-741513; FSTC-HT-23-910-72) Avail: NTIS CSCL 14/5

Affine and nonlinear means were used to estimate deformation of Type-15 aerial film, using deformation coefficients calculated on distances between corresponding point coordinate markers, to determine the feasibility of converting to nonlinear means. The experiments showed: Nonlinear means of image distortion estimation decreased remaining point coordinate errors 1.5 times below affine means; Nonlinear estimate decreased magnitude and asymmetry of distortions; Increasing the power of the polynomials used decreased the number and magnitude of maximum coordinate errors for all film samples. Decreasing image distortion increases accuracy of determining point coordinates during construction of three-dimensional photo-triangulation networks. Author (GRA)

N72-29483# Edgerton, Germeshausen and Grier, Inc., Waltham, Mass. Environmental Equipment Div.
INSTRUCTION MANUAL EG AND G MODEL 196, AIRCRAFT HYGROMETER SYSTEM Final Report, 12 Feb. 1969 - 22 Nov. 1971
Arthur Bisberg Nov. 1971 77 p
(Contract F19628-69-C-0218; AF Proj. 6020)
(AD-740638; TM-71-200; AFCRL-72-0208) Avail: NTIS CSCL 14/2

An aircraft optical dew-point hygrometer was designed and fabricated. The instrument incorporates a cryogenic heat pump to provide an extended range of mirror temperature depressional capability with rapid response. The hygrometer will be installed aboard a C-130 aircraft for flight testing. GRA

N72-29484# Army Foreign Science and Technology Center, Charlottesville, Va.
ELECTROSTATIC METHOD OF CALIBRATING PHOTOELECTRIC AEROSOL PARTICLE SIZE METERS
S. P. Belyaev and A. G. Laktionov 28 Jan. 1972 15 p refs Transl. into ENGLISH from "Elektrostaticheskiy Method Graduirovki Fotoelektricheskykh Izmeritelei Razmerov Aerozolnykh"
(AD-742130; FSTC-HT-23-107-71) Avail: NTIS CSCL 14/2

Both in the Soviet Union and abroad visual and photoelectric devices for spectrum determination and aerosol concentration are well known; however, one of the most complex problems arising during research on aerosols while using these devices is their grading. The report suggests a method of graduating devices from 0.000008 to 0.0005 cm. The known effect of charged particle fall is used for this purpose as they pass through a flat condenser. GRA

N72-29485# IIT Research Inst., Chicago, Ill.
A SMALL ELF ELECTRIC FIELD PROBE
Anthony R. Valentino Apr. 1972 52 p
(Contract N00039-72-C-0106)
(AD-742128; IITRI-E6212-1; Rept-1) Avail: NTIS CSCL 14/2

The design and development of a probe for measuring electric fields at extremely low frequencies (ELF) is described. The probe is spherically shaped and relatively small (6.3 cm in diameter) and uses a fiber-optic readout to avoid unnecessary disturbance of the measured electric field. The probe is capable of measuring fields between 10 mv/meter and 100 volts/meter. Problems encountered in the design and packaging of the probe and operational data for the probe are presented. Author (GRA)

N72-29486# National Bureau of Standards, Washington, D.C. Electronic Technology Div.
A SIMPLE HYDRAULIC SINUSOIDAL PRESSURE CALIBRATOR Final Report
John S. Hilten, Paul S. Lederer, and John Sethian Apr. 1972 33 p
(AD-742052; NBS-TN-720; COM-72-50369) Avail: NTIS;HC SOD $0.35 as C 13.46:720 CSCL 14/2

The paper describes a simple, accurate device for the sinusoidal calibration of pressure transducers. Calibration is achieved by vibrating a liquid tube on an electrodynamic shaker (vibration generator); the pressure transducer mounted at the base of the tube senses the sinusoidally varying pressure in the tube. The frequency range is 15 Hz to 2000 Hz with a maximum obtainable amplitude of 19.5 psi (134 kN/m2) peak to peak. The transducer can easily be calibrated statically in the same device, thus permitting precise correlation between static and dynamic calibrations. Agreement between static and dynamic calibrations to within 0.1% has been achieved. Author (GRA)

N72-29487# Army Electronics Command, Fort Monmouth, N.J.
INVESTIGATION OF PHOTO-ELECTROLYTIC IMAGING
Harvey A. Hodes Mar. 1972 37 p refs
(DA Proj. 1S6-62703-A-176)
(AD-742223; ECOM-3547) Avail: NTIS CSCL 14/5

An investigation of the photo-electrolytic imaging process, covering approximately five years of internal effort, yielded a variety of image forming compositions, as well as considerable fundamental insight into electrically initiated polymerization, and the function of the photoconductive layer in the overall process. The most significant factor affecting the speed of image formation proved to be the photoconductive layer. The expected amplification, or chain reaction, occurring in aqueous monomer solutions, took place to a much lesser extent in coated emulsion layers. Choice of monomer used depended more on solubility in the emulsion layer than on monomer structure. Author (GRA)

N72-29284 Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
INCREASED EFFICIENCY IN NUMERICAL PHOTOGRAMMETRY [LEISTUNGSSTEIGERUNG IN DER NUMERISCHEN PHOTOGRAMMETRIE]
F. Ackermann *In its* Rept. Relative to Cartography and Surveying, No. 53 1971 p 9-35 refs In GERMAN (For availability see N72-29283 20-13)

N72-29286 Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
PRECISION PROBABILITIES OF PHOTOGRAMMETRIC BLOCKS WITH LARGE POINT MASSES [GENAUIGKEITSERWARTUNGEN PHOTOGRAMMETRISCHER BLUECKE MIT GROSSEN PUNKTMENGEN]
H. Ebner *In its* Rept. Relative to Cartography and Surveying, No. 53 1971 p 51-71 refs In GERMAN (For availability see N72-29283 20-13)

N72-29308* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANALYSIS OF MULTISPECTRAL IMAGES SIMULATING ERTS OBSERVATIONS
Nicholas M. Short and Norman H. MacLeod *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 28 p Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 14E

N72-29309* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MICROWAVE EMISSION MEASUREMENTS OF SEA SURFACE ROUGHNESS, SOIL MOISTURE, AND SEA ICE STRUCTURE
P. Gloersen, T. Wilheit, and T. Schmugge *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 19 p refs Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 14B

N72-29318* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ENVIRONMENTAL APPLICATIONS ACTIVITY AT MARSHALL SPACE FLIGHT CENTER
Charles T. N. Paludan *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 12 p ref (For availability see N72-29302 20-13)
CSCL 14B

N72-29323* Lockheed Electronics Co., Houston, Tex.
CONSTRUCTING AND MANIPULATING COLOR IMAGERY FROM DIGITAL DATA
J. E. Davis, C. A. Helmke, T. R. Kell, M. J. Arldt, and E. L. Wilson *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 29 p Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 14E

N72-29332* Michigan Univ., Ann Arbor. Willow Run Labs.
CLASSIFICATION OF SPATIALLY UNRESOLVED OBJECTS
Richard F. Nalepka, Harold M. Horwitz, Peter D. Hyde, and James P. Morgenstern *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 13 p (For availability see N72-29327 20-13)
(Contract NAS9-9784)
CSCL 14E

N72-29340* California Univ., Berkeley. Space Sciences Lab.
AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA USING REMOTE SENSING TECHNIQUES
Robert N. Colwell *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 24 p refs (For availability see N72-29327 20-13)
CSCL 14B

N72-29349* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
MEASUREMENTS PROGRAM IN REMOTE SENSING AT PURDUE UNIVERSITY
LeRoy F. Silva *In* NASA. Manned Spacecraxt Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 33 p refs (For availability see N72-29327 20-13)
(Grant NGL-15-005-112)
CSCL 14B

N72-29354* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
POLARIZATION EFFECTS WITH A COMBINED RADAR-RADIOMETER
David Martin *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 12 p (For availability see N72-29327 20-13)
CSCL 14B

N72-29371* Geological Survey, Washington, D.C. Geographic Applications Program.
THE CENSUS CITIES PROJECT: A STATUS REPORT FOR 1971
James R. Wray *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 21 p Original contains color illustrations (For availability see N72-29355 20-13)
CSCL 14E

N72-29400* International Imaging Systems, Mountain View, Calif.
PRACTICAL UTILITY OF THE BLUE SPECTRAL REGION
Donald S. Ross *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 29 p refs Original contains color illustrations (For availability see N72-29378 20-13)
CSCL 14E

N72-29403* Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.
COASTAL AND ESTUARINE APPLICATIONS OF MULTISPECTRAL PHOTOGRAPHY
Edward Yost and Sondra Wenderoth *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 17 p refs Original contains color illustrations (For availability see N72-29378 20-13)
CSCL 14E

N72-29410* Maine Univ., Orono. Dept. of Botany.
THE USE OF KODAK AEROCHROME INFRARED COLOR FILM, TYPE 2443, AS A REMOTE SENSING TOOL
G. R. Cooper, R. L. Bowen (Agricultural Res. Serv., Weslaco, Tex.), and H. W. Gausman (Agricultural Res. Serv., Weslaco, Tex.) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 6 p refs Original contains color illustrations (For availability see N72-29407 20-13)
CSCL 14E

N72-29413* Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
MICROSCALE PHOTO INTERPRETATION OF FOREST AND NONFOREST LAND CLASSES
Robert C. Aldrich and Wallace J. Greentree *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 21 p refs (For availability see N72-29407 20-13)
CSCL 14E

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication; friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N72-29488* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPIRAL GROOVE SEAL Patent
Lawrence P. Ludwig and Thomas N. Strom, inventors (to NASA) Issued 11 Jul. 1972 5 p Filed 13 Jul. 1970 Supersedes N71-28679 (09 - 16, p 2602) Continuation-in-part of US Patent Appl. SN-723465, filed 23 Apr. 1968
(NASA-Case-XLE-10326-2; US-Patent-3,675,935; US-Patent-Appl-SN-54540; US-Patent-Class-277-27; US-Patent-Class-277-74; US-Patent-Class-277-25; US-Patent-Appl-SN-723465) Avail: US Patent Office CSCL 11A

The development of mating flat surfaces that inhibit leakage of fluid around a stationary shaft is discussed. A spiral groove pattern produces a pumping action toward the fluid when the shaft rotates which prevents leakage. A generated hydraulic lifting force separates the mating surfaces to minimize wear.
Official Gazette of the U.S. Patent Office

N72-29489*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
PROPOSED SPACE SHUTTLE CARGO HANDLING CRITERIA AT THE OPERATIONAL SITE (PRELIMINARY)

Preston E. Beck 10 Feb. 1972 17 p refs
(NASA-TM-X-68572; KSC-TR-1145) Avail: NTIS HC $3.00 CSCL 22B

The criteria for cargo handling at the operational site of space shuttles are presented, based on assumed program requirements. The concepts for the following functions are described: maintenance and checkout facility, transfer to launch pad, and launch pad. The requirements for the ground equipment are given along with the general sequences for cargo loading. F.O.S.

N72-29490*# North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering.
AN EXPERIMENTAL STUDY OF THE CRYOENTRAINMENT PUMP AND THE BEHAVIOR OF NUDE IONIZATION GAUGE AT LOW TEMPERATURE Final Summary Report
J. A. Daggerhart 10 May 1972 36 p
(Grant NGR-34-002-106)
(NASA-CR-112128) Avail: NTIS HC $4.00 CSCL 13K

The use of cryopumping techniques to obtain a contamination free vacuum is discussed. Of those gases that are normally present in an initially air filled vacuum system, only carbon dioxide and water vapor will be effectively pumped at 77 degrees Kelvin. In order to circumvent this restriction on the types of gases that are pumped at this temperature, it is postulated that a gas which is easily condensable at 77 degrees K be injected into the system in the form of a directed stream. The stream would then entrain the normally noncondensable species by a momentum transfer mechanism. After sweeping through the volume to be pumped, the injected gas stream would then be condensed on a cryopumping surface maintained at 77 degrees Kelvin. Author

N72-29491*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRICTION AND WEAR LIFE PROPERTIES OF POLYIMIDE THIN FILMS
Robert L. Fusaro Washington Aug. 1972 15 p refs
(NASA-TN-D-6914; E-6960) Avail: NTIS HC $3.00 CSCL 11H

A transition in the friction coefficient and wear life properties of Pyralin polyimide (PI) thin films was found to exist at a temperature between 25 deg and 100 deg C. Above this transition, PI thin films gave long wear lives and low friction coefficients. The presence of H2O in air improved the friction and wear life properties at 25 deg C; but at 100 deg C, H2O had a detrimental effect. At 100 deg C and above, a dry argon atmosphere gave lower friction coefficients and longer wear lives than did a dry air atmosphere. Author

N72-29492# National Bureau of Standards, Washington, D.C.
THE SCIENCE OF CERAMIC MACHINING AND SURFACE FINISHING
S. J. Schneider, Jr. (Ed.) and R. W. Rice (Ed.) May 1972 395 p refs Conf. held at Gaithersburg, Md., 2-4 Nov. 1970; sponsored by Am. Ceramic Soc., Office of Naval Res., and NBS
(NBS-SP-348; LC-79-611323) Avail: SOD $5.25 as C 13.10:348

The proceedings of a conference on the science of ceramic machining and surface finishing are presented. Data cover current problems and research programs. In addition to a panel discussion, 37 review and original research papers are presented with attention focused on four main areas: (1) Techniques and Mechanisms of Removal and Shaping (2) Surface Treatment (3) Analysis and Characteristics of Machining Effects, and (4) Mechanical and Other Effects of Finishing. An edited version of the floor discussions follows each paper. For individual titles, see N72-29493 through N72-29528.

N72-29493 Rhode Island Univ., Kingston.
MECHANICAL METHODS OF CERAMIC FINISHING
Peter J. Gielisse and Joseph Stanislao *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 5-35 refs (For availability see N72-29492 20-15)

Mechanical methods of finishing ceramics were reviewed based on current practice as well as past and present research results. A total systems evaluation involves technical process and economic parameters. State of the art information indicates a need for scientific evaluation of the basic stock removal process. Experiments simulating grinding with single point diamond tools have generated quantitative and qualitative data on mechanical, dynamic, and thermal aspects of the stock removal process. Generation of the data involved specially designed techniques. Analysis of the results was made in terms of mechanical, geometric and material parameters. A mechanical and thermodynamic model is presented. Author

N72-29494 Electrotechnical Lab., Tokyo (Japan).
DIRECT OBSERVATION OF MATERIAL REMOVAL PROCESS DURING GRINDING OF CERAMICS BY MICRO-FLASH TECHNIQUE
Osamu Imanaka, Seiji Fujino, and Shin-ei Mineta *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 37-43 (For availability see N72-29492 20-15)

Chip removal processes were observed during grinding with a specially built set-up which consists of a flash lamp, synchronizer, microscope, and motor driven camera. The experiments were done mainly by using one grain of diamond attached to a disk which was mounted on a shaft of a surface grinding machine. Workpiece materials examined were glass-ceramics and several types of oxide ceramics, e.g., alumina, forsterite, and steatite ceramics. The main results obtained are as follows: Under moderately large depth of cut, the chips generated from ceramics are generally of a fragment type and are distinguished from those of ductile materials. Part of these chips were observed to be removed, of course, directly by the grain, but a considerable part of them were found to splinter out of the workpiece surface in a short time after the grain has passed over. Possible explanations are proposed for those phenomena. The above mentioned facts suggest that a damaged layer may remain under the ground surface of ceramic materials. It is also demonstrated that chips of continuous type are occassionally observed at high grinding speed and under moderately small depth of cut. The chip formation of this type depends delicately on the materials to be ground. Author

N72-29495 Carborundum Co., Niagara Falls, N.Y.
GRINDING: A MEANS OF SHAPING AND SIZING CERAMICS
J. A. Mueller *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 45-52 (For availability see N72-29492 20-15)

The capability of abrasive grinding wheels to shape and size ceramic bodies, those harder than 800 Knoop and those softer than 800 Knoop, is discussed. The grinding wheel must also be capable of removing stock, generating geometry, and producing fine finishes. Suggestions are given for starting speeds, feeds, and wheels together with a list of practical everyday rules of thumb for efficient grinding. Author

N72-29496 Owens-Illinois, Inc., Toledo, Ohio.
ASPECTS OF MACHINING GLASS-CERAMIC MATERIALS
G. H. Allgeyer and L. V. Colwell (Michigan Univ.) *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 53-57 refs (For availability see N72-29492 20-15)

Machinability studies were conducted on CER-VIT glass-ceramic material using diamond abrasive tooling while adjusting the controllable machine variables. The results and relationships of these techniques as applied to CER-VIT glass-ceramic are discussed. Significance of the experimental results are explored with particular emphasis being placed upon the predictable performance of diamond tools and the feasibility of programming of machining variables for utilization of numerically controlled machining processes. Author

N72-29497 Cincinnati Milacron Corp., Worcester, Mass.
THE PRINCIPLES OF GRINDING
Robert S. Hahn and Richard P. Lindsay *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 59-72 refs (For availability see N72-29492 20-15)

Equations relating the stock removal rate and the interface force intensity are developed and a material removal parameter is defined. Similar equations for the wheel wear and a "wheel wear parameter" are also developed. It is found for many materials that the stock removal rate is a linear function of the interface force intensity. However, the abrasive removal rate or dimensional wheel wear is found to vary approximately as the square of the interface force intensity. Increasing wheel surface speed is generally found to raise the material removal parameter. The essential parameters in dressing with single pointed diamonds are introduced and their effect on controlling the sharpness of a grinding wheel is discussed. Semiempirical equations for predicting wheel wear are given in terms of force intensity, wheel hardness and wheel-workpiece conformity. The factors influencing surface finish are described including the dressing lead, the depth of cut of the dresser diamond and the interface force intensity. Thermal damage and surface integrity are discussed. The existance of a threshold force intensity (or feed rate) below which no thermal cracking takes place is shown. Raising the workspeed tends to raise this threshold. Wheel sharpness is also found to be an important variable and means for quantitatively measuring wheel sharpness are given. Author

N72-29498 De Beers Diamond Research Lab., Johannesburg (South Africa).
A BASIC STUDY OF THE DIAMOND GRINDING OF ALUMINA
D. M. Busch and J. F. Prins *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 73-87 refs (For availability see N72-29492 20-15)

Experiments were performed using single diamond points to cut Coors AD96 alumina, under conditions simulating the grinding of this material. These studies involved different diamond particles and the forces were recorded during the cutting action. Parallel to the single diamond experiments, grinding tests were performed on the same ceramic material using the same types of diamonds with which the single point studies were done. The grinding experiments and the single diamond experiments were then compared to get a better understanding of the actual cutting mechanism involved when grinding aluminum oxide. The wear of the diamond particles and the damage inflicted on the ceramic material were studied with the aid of electron-microscopy. A relationship was found between the forces measured, the deterioration of the bonding material, and the wear of the diamonds. Special attention was given to diamonds of the MDA-S type, a blocky, sharp edged diamond grit, and diamond spheres. These two types of diamonds were compared in grinding, and showed similar results due to the production of flat areas on the spheres, and the movement and wear of the blocky particles in the bonding material to present flat faces to the workpieces. The grinding experiments also entailed a study of machine vibrations, especially chatter vibrations and the grinding noise associated with it. Author

N72-29499 Stanford Research Inst., Menlo Park, Calif.
ON THE STRENGTH OF CERAMICS AS A FUNCTION OF MICROSTRUCTURE, GRINDING PARAMETERS, SURFACE FINISH, AND ENVIRONMENTAL CONDITIONS c18
Rudolf Sedlacek, F. A. Halden, and P. J. Jorgensen *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 89-97 refs (For availability see N72-29492 20-15)

The tensile strength of four aluminas is described in terms of their microstructure and composition. The effect of microstructure on the attainable surface finish is discussed, and the results of profilometric evaluation of ground surfaces are presented. Various postgrind treatments are shown to have differing effects on microstructure. Griffith's flaw theory is applied to aluminas of different grain sizes, and calculated strengths are found to agree with experimental data. The phenomena of delayed fracture and stress corrosion are discussed; the strength of alumina is found to be higher under vacuum than in air and is independent of stress rate. Author

N72-29500 De Beers Diamond Research Lab., Johannesburg (South Africa).
GRINDING ALUMINA WITH DIAMOND ABRASIVES
R. J. Caveney and N. W. Thiel *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 99-112 refs (For availability see N72-29492 20-15)

Following extensive work on the application of diamond for tungsten carbide and steel grinding, various aspects of ceramic grinding with diamonds were investigated. Ceramics with three different alumina contents were ground with a variety of diamond types both natural and synthetic to establish what effect changes in wheel speed have when surface grinding these materials. The mode and extent of damage of the ground surfaces of the specimens were investigated using conventional electron microscopy. In addition to these investigations, measurements were made of the quality of the surface finishes that can be obtained under different grinding conditions. Variations in grinding efficiency, machining costs and surface damage are discussed for the three alumina grades tested. The mechanism of wear of the different diamond types was studied and is demonstrated by means of scanning electron micrographs. Also reported are the initial results obtained from tests on cylinders of the same three alumina grades mentioned above. These initial tests were aimed at finding the most suitable combination, from the point of view of wheel life, of wheel and workpiece speeds, and incorporated tests with both natural and synthetic grits.
Author

N72-29501 National Bureau of Standards, Boulder, Colo. Instrument Shops Div.
CERAMIC SUBSTRATE AND SPECIMEN FABRICATION
H. C. Leistner and W. A. Wilson *In its* The Sci. of Ceramic Machining and Surface Finishing May 1972 p 113-117 refs (For availability see N72-29492 20-15)

Procedures were developed to fabricate ceramic materials used as substrates for precision, coaxial, thin film resistors. Excellent radio frequency characteristics were obtained from this procedure in developing radio frequency standards at the National Bureau of Standards at power levels of 10 milliwatts to 100 watts and frequencies from direct current to 4.0 gigahertz. Substrates fabricated for this purpose require precise tolerances and surface finish to insure uniformity of thin films deposited on a ceramic substrate. In addition, procedures were developed to fabricate specimens used in determining the dielectric and magnetic properties of ferrites, insulating ceramics, glass, fused silica, and single crystal materials. A variety of shapes are required including spheres, rods, disks and ellipsoids. Precise tolerances are required to obtain qualitative property measurements of the materials involved. In both procedures, special techniques are used with existing equipment in grinding ultrasonic machining, lapping and polishing to obtain the required end product. The application of the required products and the methods used to fabricate these products are discussed. Author

N72-29502 General Motors Research Labs., Warren, Mich.
ON THE SHAPING OF BRITTLE SOLIDS BY EROSION AND ULTRASONIC CUTTING
H. L. Oh, K. P. L. Oh (Calif. Univ., Berkeley), S. Vaidyanathan (Calif. Univ., Berkeley), and I. Finnie (Calif. Univ., Berkeley) *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 119-132 refs (For availability see N72-29492 20-15)

It is shown that fracture loads of indenters subjected to normal force may be predicted from conventional strength tests by using Weibull's statistical treatment of brittle strength. It is then shown that Weibull's procedures may be extended to predict the distribution of fracture location in brittle solids. For the case of a spherical indenter under normal and tangential forces, many cracks may form as the load is increased. It is

shown that the location of the outermost of these cracks may be predicted. Estimates may also be made of the depth of cracking and thus the extent of the cracking produced by a single contracting particle may be described. These results may be applied directly to study the process of erosive shaping. The influence on volume removal of changes in the velocity and size of the impacting particles is predicted and shown to be in accord with experiment. Many other features of the erosion process may be described including a transition to ductile behavior in the case of glass when the impacting particles are small enough. The analysis of ultrasonic cutting presents greater difficulty because the distribution in size of the abrasive grains is of great importance. However, predictions may be made for the influence of load, grain size, and material properties on the rate of volume removal and these are shown to be in general accord with experiment. Author

N72-29503 Ohio State Univ., Columbus.
SONIC MACHINING OF CERAMICS
William B. Campbell *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 133-139 refs (For availability see N72-29492 20-15)

The effect of 10 kHz sonic vibrations on the shaping and finishing of fired ceramic shapes was investigated to identify optimum machining conditions commensurate with product and surface quality. Sonic motors, developed at The Ohio State University and with outputs up to 15 horsepower, were used to activate the machine tool. Significant improvements in tool wear were observed in impact-tuned systems that produced removal rates greater than 45 cu in per min. Template and profile tooling were successfully used to obtain open cutting surfaces. Over 3000 test cuts provided the data necessary to identify optimal parameters of operation. Author

N72-29504 Martin Marietta Corp., Baltimore, Md. Research Inst. for Advanced Studies.
ENVIRONMENT-SENSITIVE MACHINING BEHAVIOR OF NONMETALS
A. R. C. Westwood and R. M. Latanision *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 141-154 refs (For availability see N72-29492 20-15)

Liquid environments can influence the efficiency of machining nonmetallic solids in a variety of ways, e.g., by serving as lubricants, coolants, or particle dispersants. More importantly, however, certain environments can markedly increase or decrease the hardness of the nearsurface regions of such solids, and thereby exert a profound influence both on the rate of material removal and on tool life. Because of its technological potential, the characteristics and possible mechanisms of this latter phenomenon--the Rebinder effect--receive primary consideration. For crystalline ceramics, Rebinder effects in machining arise because of the influence of the environment on nearsurface dislocation behavior. Effects resulting from adsorption-induced changes in the surface free energy of the solid are of minor importance. Rebinder effects can also occur in noncrystalline solids, however, and recent observations on such effects in various glasses are described. The possibility that these effects are caused by a stress-plus-chemisorption-induced redistribution of sodium ions in the near-surface region is discussed. The importance of considering the total cutting system, environment-solid-tool, in any account of environment-sensitive machining is stressed, for environments which facilitate material removal when one type of tool is used can be detrimental to the effectiveness of another tool with a different cutting action. Author

N72-29505 Brookhaven National Lab., Upton, N.Y.
SHAPING OR FIGURING CERAMIC SURFACES BY ION BEAM BOMBARDMENT
Paul W. Levy *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 155-169 refs Sponsored in part by ARPA and AEC (For availability see N72-29492 20-15)

The shaping or figuring of glass and ceramic surfaces by ion beam erosion is a relatively new technique. All operations are carried out in a vacuum. Usually the optic is bombarded by a collimated beam of rare gas ions whose energy is between 1-100 keV. Selected areas can be eroded by electrostatically deflecting the beam or, less conveniently, by moving the optic. The erosion area can be controlled by focusing the beam with electrostatic or magnetic lenses. The basis of the erosion process is the physical phenomenon known as sputtering. For ceramic materials typical erosion rates are on the order of angstroms/microamps sq cm/min and increase with increasing angle of incidence. Ion-beam currents up to 100 microamp/sq cm are practical. Under these conditions the material struck by the beam may reach temperatures between 300 and 700 C. The maximum lattice disruption occurs at a depth of one incident ion range from the original surface, just as the eroding surface reaches this point. Additional bombardment does not increase the damage beyond this maximum. Furthermore, the damage is minimized by using bombardment conditions which maximize the temperature in the target. It is not known if there are any radiation damage effects which reduce the usefulness of ion-beam figured optics. At the moment, it would appear that ion-beam figuring is a practical technique for touching up conventional optics and, more importantly, for fabricating nonspherical or nonaxially symmetrical optics. Also, the ion-beam erosion process is particularly amenable to computer control. Author

N72-29506 Naval Research Lab., Washington, D.C. Chemistry Div.
THE EFFECT OF SPUTTERING ON SURFACE TOPOGRAPHY AND STRENGTH OF CERAMICS c18
R. W. Rice *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 171-187 refs (For availability see N72-29492 20-15)

The topography developed as a result of RF sputtering on a variety of ceramic surfaces is described showing that surface cracks, scratches, pits, etc., are fairly rapidly rounded out. Generally, this occurs without differential grain boundary sputtering. However, some bodies develop a rough finish due to nonuniform microstructural removal. Limited trials with ion beam sputtering show it also rounds cracks, etc., but does not develop a rough finish on bodies that will with RF sputtering. Because of the rounding of stress concentrating features and generally similar effects on single and polycrystalline bodies, sputtering was investigated as a substitute for flame polishing, but with much wider applicability. Flame polished strengths were not obtained. However, some materials (e.g., $MgAl_2O_4$) do show greater improvements in strengths than others (e.g., Al_2O_4) as a result of sputtering. These differences are discussed and results compared with other methods of surface finish. Both the detailed nature of the sputtered surface as well as enhancement of grain boundaries and other microstructural features under certain conditions indicate that sputtering may also be useful as an etching technique. Author

N72-29507 Perkin-Elmer Corp., Wilton, Conn.
COMPUTER CONTROLLED IONIC POLISHING OF OPTICAL SURFACES
James W. Douglass *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 189-192 refs (For availability see N72-29492 20-15)

Results of the development of an ionic polishing investigation are described. During this investigation many controlled polishing experiments were performed. The results of two of these experiments are presented. In the first of these, a 0.203 m diameter optical flat of fused silica was polished to a diffraction limited surface quality of 95A (9.5 nm) rms. The second experiment described was the conversion of a 0.203 m diameter Cervit sphere into a f/5 paraboloid of diffraction limited quality by using analytical expressions to generate the removal distribution. The ionic polishing process was computer controlled for this experiment. The temporal stability and optical scatter performance of ionically polished surfaces has been determined to be as good as or better than conventional surfaces. Author

N72-29508 Naval Research Lab., Washington, D.C.
ARC, LASER, AND ELECTRON BEAM MACHINING OF CERAMICS
R. W. Rice *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 193-195 refs (For availability see N72-29492 20-15)

The various types of arc, laser, and electron beam machining, the considerations that are required in their operations, and some of the applications for which they have been tried or used, are briefly reviewed. The most general consideration is whether thermal shock and stress cracking will be a problem. The environmental and material parameters, which vary substantially with the types of these different machining processes, can also be quite important. Meeting the requirements of all these considerations does limit the versatility and applicability of these techniques. Nevertheless, they deserve consideration for a variety of applications. Author

N72-29509 Little (Arthur D.), Inc., Cambridge, Mass.
THE TECHNIQUES AND MECHANISMS OF CHEMICAL, ELECTROCHEMICAL, AND ELECTRICAL DISCHARGE MACHINING OF CERAMIC MATERIALS
D. William Lee and George Feick *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 197-211 refs (For availability see N72-29492 20-15)

Electrochemical machining (ECM), electrical discharge machining (EDM), chemical machining (CHM) techniques have not been extensively used as a material removal process for ceramics. The fact that these processes are not dependent upon the hardness of the workpiece should make them attractive for the shaping of ceramics. However, ECM and EDM techniques are limited to material with reasonably good electrical conductivity while CHM may be limited by the availability of effective etchants and the nature of the ceramic itself. The theory and techniques of chemical, electrochemical and electrical discharge processes are reviewed. The variables and important parameters of the material removal processes are discussed, including etchants and mask techniques for chemical milling; current-voltage characteristics, dielectric fluids, electrode materials, etc., for EDM; electrolytes, gap effects current density etc., for ECM. The available information and experiences developed on metals and alloys are used to examine the applications and limitations of these processes on the surface condition, microstructure, and subsequent material properties are pointed out. Finally, comments will be made on the technical and economic feasibility of ECM, EDM, and CHM processes for the shaping, cutting, and finishing of crystalline ceramics. Author

N72-29510 General Electric Co., Philadelphia, Pa.
IMPROVEMENTS IN THE SURFACE FINISH OF CERAMICS BY FLAME POLISHING AND ANNEALING TECHNIQUES
M. J. Noone and A. H. Heuer (Case Western Reserve Univ., Cleveland, Ohio) *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 213-232 refs (For availability see N72-29492 20-15)

Improvements in the surface perfection (i.e. "smoothness") of ceramics can be achieved by thermal treatments at temperatures where material transport may be induced at the surface. Such treatments include annealing in controlled environments, where surface diffusion, vapor transport mechanisms, etc., may be active, and flame polishing, where a thin layer at the surface of the material is melted, allowed to flow freely, and then resolidified. The effects of these treatments on the surface of single crystals of alpha-Al2O3 are reviewed. The most sensitive assessment of the degree to which surface perfection is attained is the measurement of the strength of the treated crystals. For this reason, strength data are used extensively to characterize the thermal treatments described. In the case of flame polishing, it found that a sufficient degree of surface perfection can be attained so that the strength is no longer limited by surface defects (the usual experience with ceramics) but by defects within the material. The technological significance of high strength Al2O3 filaments for reinforcement of metals and the unfortunate deterioration of the surface in these applications is briefly described. Author

N72-29511 Westinghouse Research Labs., Pittsburgh, Pa.
HEALING OF SURFACE CRACKS IN CERAMICS
F. F. Lange *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 233-236 refs Sponsored in part by Navy (For availability see N72-29492 20-15)
(NR Proj. 032-507)

The effects of grinding, cutting, thermal shocking, impacting and rough handling on surface cracks that degrade the strength of ceramics are discussed. It has been shown that, once introduced, these cracks can be eliminated by either resintering the damaged ceramic component for the case of oxides or oxidizing the component for the case of materials such as SiC. Results of crack healing experiments, performed on Al2O3, ZnO and SiC are reviewed. The technical implications of these results are discussed as related to abrasive machining. Author

N72-29512 Naval Research Lab., Washington, D.C.
FLAME POLISHING OF FLAT OXIDE BARS
P. F. Becher and R. W. Rice *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 237-245 refs (For availability see N72-29492 20-15)

Some of the problems and limitations of flame polishing flat bars are discussed. Results are presented for single crystal, alpha-Al2O3, as well as for more limited trials of MgAl2O3, TiO2 and soda lime glass. The wide variability of strength is partially related to variations in surface, but twinning also appears to be important in sapphire and TiO2. Preliminary results on twin sources and their effect on strength of sapphire are discussed. Author

N72-29513 Tyco Labs., Inc., Waltham, Mass.
CONTINUOUS FLAME POLISHING OF SAPPHIRE FILAMENT
J. T. A. Pollock *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 247-257 refs (For availability see N72-29492 20-15)
(Contract F33615-69-C-1369)

Continuous flame polishing of single crystal sapphire filaments has resulted in enhancement of the tensile fracture strength. Flame polishing was carried out in a continuous manner using an oxygen/hydrogen flame. Data are presented which suggest that the enhancement is not entirely dependent on the production of a more perfect Al2O3 surface. Increases in strength are reported for filaments which have passed through flames not sufficiently hot for surface melting to occur. Maximum strength enhancement is obtained when the oxygen/hydrogen flame temperature is such that an axial molten zone two to three times the filament diameter is produced at the filament surface. Experiments to determine the state of stress in the filament before and after polishing are described. Author

N72-29514 Naval Research Lab., Washington, D.C.
PREPARATION OF SMOOTH CRYSTALLINE, DAMAGE FREE, SAPPHIRE SURFACES BY GASEOUS ETCHING
W. A. Schmidt and John E. Davey *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 259-265 refs (For availability see N72-29492 20-15)

The preparation of smooth crystalline, damage free, sapphire surfaces by gaseous etching is discussed. Experiments in removing surface damage were performed with hot phosphoric acid and with hydroxide etches. Two other surface treatments are reported. One is a hydrogen firing technique in which the substrates are heated in a resistance furnace hydrogen environment. The second was radio frequency heating of a carbon susceptor in an atmosphere of helium and freon. Reflection electron diffraction was used to determine the surface crystalline order, and electron microscopy was used to examine the topography structure of the surfaces. Author

N72-29515 Naval Research Lab., Washington, D.C.
THE STRENGTH OF GAS POLISHED SAPPHIRE AND RUTILE c18
R. W. Rice, P. F. Becher, and W. A. Schmidt *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 267-269 refs (For availability see N72-29492 20-15)

Surface polishing of alpha-Al2O3 using a helium-Freon gas mixture at elevated temperatures is shown to yield bend strengths comparable to flame polished sapphire. However, the gas polishing process proved to be more versatile as evidenced by the success with flat bar surfaces. Further, the process can be readily applied to some other materials as demonstrated by the substantial improvements in the strength of TiO2 after gas polishing. Limited attempts at polishing other ceramic materials are also discussed, as well as observations on strength variations and fracture behavior. Author

N72-29516 Bell Telephone Labs., Inc., Allentown, Pa.
ANALYSIS AND CHARACTERIZATION OF CERAMIC SURFACES FOR ELECTRONIC APPLICATIONS c18
R. C. Sundahl and L. Berrin *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 271-291 refs (For availability see N72-29492 20-15)

The use of a ceramic surface as a support for complex thin film conductor patterns which serve to interconnect silicon integrated circuit chips is discussed. Those ceramic surface parameters which are found to be critical to this application are: (1) topographical properties, (2) chemical properties, and (3) crystallographic properties. These properties are characterized using such tools and techniques as optical, transmission electron and scanning electron microscopy, profilometry, electron microprobe analysis, ion microprobe analysis, Auger electron spectroscopy and electron diffraction. Special emphasis is placed on the relationship between the results of such analyses and the performance of the surface as part of the SIC interconnect system. Author

N72-29517 Accumet Engineering Corp., Hudson, Mass.
SURFACE CHARACTERISTICS OF CERAMIC SUBSTRATES FOR HYBRID AND MICROWAVE ELECTRONIC CIRCUITS c18
Jackson K. Emery *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 293-300 refs (For availability see N72-29492 20-15)

Several methods currently used for finishing ceramic substrates in ready-for-deposition state are discussed, including firing, glazing, burnishing, grinding, lapping, and polishing. Each method tends to exhibit a different and typical combination of surface characteristics, such as variations in thickness, parallelism, camber, waviness, roughness, and localized defects. Each of these in turn may influence the deposition process, performance, and reliability. Analysis of some typical surface details, particularly roughness and waviness, as significant surface factors capable of affecting process or function, is presented with comments on instrumentation and measurement procedures. Significant differences exist in the use of terms relating to substrate surfaces and their characteristics. A need is indicated for more particularized use of such terms, and for recognition of uniform definitions. Clarification of terminology may facilitate improved communications and measurements, which in turn may correlate with current and future requirements in circuit production. Several existing applicable standards are referenced, and definitions of terms are suggested. Author

N72-29518 Bell Telephone Labs., Inc., Allentown, Pa.
CERAMIC SURFACE TEXTURE BY REFLECTIVE REPLICA TECHNIQUE c18
Wing C. Lo *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 301-308 (For availability see N72-29492 20-15)

Surface texture as a parameter of general concern in the study of thin film metallizing adherence on ceramic substrates is discussed. It refers to the geometrical character of the surface irregularities recurring many times across the ceramic surface tending to form a pattern. In this context, surface texture is determined by the size, shape, arrangement and distribution of the surface constituents. A convenient method by which the surface texture of ceramic substrates can be visually assessed and recorded photographically using a simple metallographic microscope is presented. Examples in applying this technique for distinguishing and differentiating surface textures of different types of ceramic substrates are given. Use of the technique for identifying surface defects is also shown. Author

N72-29519 Pennsylvania State Univ., University Park.
QUANTITATIVE SURFACE FINISH CHARACTERIZATION BY CESEMI c18
E. W. White, H. A. McKinstry, and A. Diness (Office of Naval Res., Arlington, Va.) *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 309-316 refs (For availability see N72-29492 20-15)
(Contract N00014-67-A-0385)

A feasibility for quantitative characterization of surface finishes based on the computer evaluation of scanning electron microscope images (CESEMI) has been established. Measurement of the number, size, shape and orientation of isointensity (or selected intensity interval) regions constitute the basic analysis. Brightness in SEM images varies as a function of the steepness of slope of the surface at a given point. In their analysis, the characteristics of grooves, pits, ridges, etc., can be studied separately. Detailed interpretation of the results are not attempted in this preliminary study. A feasibility for recording and analyzing profilometer rasters has also been demonstrated. Such recordings are, in essence, true three dimensional images of surface topography insofar as the profilometer stylus faithfully follows the surface morphology. Analysis of these profilometer recordings by the basic CESEMI computer programs yield direct descriptions of the topography. The SEM image and profilometer image analyses appear to be complementary techniques. One obvious advantage of the SEM image analysis is that it is a no-contact technique hence, there are no problems introduced by stylus damage. Author

N72-29520 Honeywell, Inc., Hopkins, Minn.
AN ASSESSMENT OF SURFACE AND SUBSURFACE DAMAGE INTRODUCED IN CERAMICS BY SEMIFINISH GRINDING OPERATIONS c18
B. G. Koepke *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 317-332 refs Sponsored by Navy (For availability see N72-29492 20-15)

The nature and extent of grinding damage introduced by surface grinding a number of ceramics having widely varying mechanical properties has been studied. Surface damage has been characterized by optical and electron microscopy and subsurface damage has been observed using etch pit techniques. Grinding damage was found to depend strongly on wheel type and rate of material removal as well as on the mechanical behavior and microstructure of the workpiece. The results indicate that grinding damage is mainly composed of mixtures of three types depending on the mechanism of material removal. Author

N72-29521 National Bureau of Standards, Washington, D.C.
OBSERVATIONS ON MECHANICALLY ABRADED ALUMINUM OXIDE CRYSTALS BY TRANSMISSION ELECTRON MICROSCOPY c26
Bernard J. Hockey *In its* The Sci. of Ceramic Machining and Surface Finishing May 1972 p 333-339 refs (For availability see N72-29492 20-15)

Use of the argon ion-bombardment thinning technique has made possible the examination of the near surface regions of mechanically abraded aluminum oxide by transmission electron microscopy. Observations on diamond-polished, aluminum-polished, and diamond-ground specimens have shown that subsurface damage as well as surface damage is typically produced. Specifically, mechanical polishing introduces relatively

high densities of dislocations to a depth of approximately one micron from the original surface. The dislocations are generally in the form of half-loops and are clearly associated with surface scratches produced by individual abrasive particles. Author

N72-29522 Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
ACOUSTIC EMISSION MONITORING OF SURFACE-DAMAGED CERAMIC MATERIALS c18
L. R. Bunnell, J. C. Crowe, and P. E. Hart *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 341-342 refs (For availability see N72-29492 20-15)

The acoustic emission response of Lucalox, fused silica, single crystal alumina, Pyroceram, and soda-lime-silica glass to surface damage is reported. Low temperature annealing at 200 C reduces the response levels. Annealing at 400 C removes all of the induced acoustic activity. Author

N72-29523 Honeywell, Inc., Hopkins, Minn.
EFFECTS OF SURFACE FINISHING ON MECHANICAL AND OTHER PHYSICAL PROPERTIES OF CERAMICS c18
Robert J. Stokes *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 343-352 refs (For availability see N72-29492 20-15)

The effects of mechanical finishing operations on the physical properties of ceramics are discussed. Ceramic machining results in a defective surface containing cracks, dislocations, point defects, and residual stresses. The relative significance of these defects depends on the physical properties of interest. The mechanical properties of single crystals are sensitive to dislocations (semibrittle) and surface cracks (brittle). The mechanical properties of polycrystals are sensitive to surface cracks. The electrical properties of semiconductors are sensitive to surface trapping sites. Magnetic, piezoelectric, and optical properties are particularly sensitive to residual stresses. To optimize physical properties, these defects must be eliminated by mechanical lapping, chemical etching, or thermal annealing. Author

N72-29524 Ceramic Finishing Co., State College, Pa.
STRENGTH EFFECTS RESULTING FROM SIMPLE SURFACE TREATMENTS c18
H. P. Kirchner, R. M. Gruver, and R. E. Walker *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 353-363 Sponsored by Navy (For availability see N72-29492 20-15)

In well made polycrystalline alumina ceramics subjected to external loads, fracture originates, in almost every case, at surface flaws rather than at volume flaws. Information can be gained by using simple treatments to change these artificial surface flaws and by observing the effect of these treatments on the strength. Artificial flaws were introduced by single point tools, abrading, thermal shock, and abrasive machining. The flaws were treated by refiring, chemical and flame polishing, chemical etching, glazing and prolonged storage in various environments. The changes in the flaws were characterized by microscopy and to a limited extent by profilometry. Both flexural and tensile strengths were measured. The effects of the treatments are discussed in terms of changes in the average strength and variations in the distribution of the individual strengths. Author

N72-29525 Naval Research Lab., Washington, D.C.
THE EFFECT OF GRINDING DIRECTION ON THE STRENGTH OF CERAMICS c18
R. W. Rice *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 365-376 refs (For availability see N72-29492 20-15)

It is shown that grinding bars in a direction parallel with the tensile axis has limited effects on their strength, while grinding perpendicular to the tensile axis may have no effect or can reduce strengths as much as 50 percent. In single crystals, the reduction in strength generally increases with the hardness of the material, but can also depend on crystallographic orientation. In polycrystalline bodies, the reduction also depends a great deal on grain size, with the effect generally increasing with decreasing grain size. Also the effect tends to be greater in polycrystalline bodies that are weaker than normal. The effect of grinding direction on strength is attributed to stress concentrations due to grinding stria, whose continuity and depth generally increase with hardness. The severity of these stria tends to increase as the amount of plastic deformation in the machined surface decreases. The amount of plastic deformation is shown to vary approximately inversely with hardness. The effect of varying strength with grinding direction on the interpretation of various tests is discussed. Author

N72-29526 Southern Research Inst., Birmingham, Ala.
THE INFLUENCES OF MATERIAL REMOVAL ON THE STRENGTH AND SURFACE OF AN ALUMINA c18
H. S. Starrett *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 377-387 refs (For availability see N72-29492 20-15)

A quantitative investigation of test methods used to evaluate brittle materials is discussed. The material for this study is a high purity, high density alumina. The primary scope of the total program is a study of test methods, scaling laws and surface finish effects. The scope has been broadened to include the effects of property interactions on strength and the relationships between micro and macro characterization and the mechanical properties. Initial tensile and flexural data indicated that surface finish had no effect on the tensile strength of this particular alumina. Since this was contrary to generally accepted results, considerable effort has been expended in investigating this phenomenon. It has been postulated that the lack of an effect may have been due to subsurface damage that occurred during the grinding operations. Author

N72-29527 Stanford Research Inst., Menlo Park, Calif.
THE EFFECT OF GRINDING VARIABLES ON THE STRENGTH AND SURFACE FINISH OF ALUMINA c18
Rudolf Sedlacek, F. A. Halden, and P. J. Jorgensen *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 391-398 refs (For availability see N72-29492 20-15)
(Contracts NOw-66-0383-d; N00019-67-C-0494)

The tensile strength of alumina is used as a criterion for the evaluation of the effects of variables encountered in diamond grinding of ceramics. The variables studied include the grit size of diamond, rate of material removal, and sparkout. The difference in performance of natural and synthetic diamond is shown, and the feasibility of dry grinding is discussed. The ground surfaces were examined using profilometry, and transmission electron and scanning electron microscopy. The strengths of test specimens having ground or as-fired surfaces are compared. Author

N72-29528 Bell Telephone Labs., Inc., Allentown, Pa.
EDGE EFFECT ON THE MODULUS OF RUPTURE OF CERAMIC SUBSTRATES c18
Wing C. Lo *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 399-400 (For availability see N72-29492 20-15)

Because of its simplicity, the modulus of rupture (or flexural strength) test is often used to evaluate the mechanical strength of ceramics. For large flat substrates, the natural tendency is to test specimens cut from the substrate. Depending on the method of cutting and the resulting edge condition of the specimen, the flexural strength can be significantly different. This is illustrated by 3-point loading data on CO2-laser-scribed and diamond-sawed specimens. The modulus of rupture of a laser-cut sample is about 70 percent of that of a diamond-sawed sample. Author

N72-29529*# Hough Lab., Springfield, Ohio.
IMPROVEMENT OF CHEMICAL VAPOR DEPOSITION PROCESS FOR PRODUCTION OF LARGE DIAMETER

CARBON BASE MONOFILAMENTS Technical Report, Nov. 1970 - Nov. 1971
R. L. Hough and R. D. Richmond Nov. 1971 47 p refs
(Contract NAS3-14325)
(NASA-CR-120902) Avail: NTIS HC $4.50 CSCL 13H

Research was conducted to develop large diameter carbon monofilament, containing 25 to 35 mole % element boron, in the 2.0 to 10.0 mil diameter range using the chemical vapor deposition process. The objective of the program was to gain an understanding of the critical process variables and their effect on fiber properties. Synthesis equipment was modified to allow these variables to be studied. Improved control of synthesis variables permitted reduction in scatter of properties of the monofilaments. Monofilaments have been synthesized in the 3.0 to nearly 6.0 mil diameter range having measured values up to 552,000 psi for ultimate tensile strength and up to 30 million psi for elastic modulus. Author

N72-29530# Joint Publications Research Service, Arlington, Va.
WELDING OF HIGH STRENGTH STEELS
A. M. Makara and N. A. Mosendz 19 Jul. 1972 38 p refs Transl. into ENGLISH from the book "Svarka Vysokoprochnykh Staley' Kiev, Tekhn. Publ. House, 1971 140 p
(JPRS-56540) Avail: NTIS HC $4.00

Brief information is presented on the composition and properties of high-strength steels. Questions of their weldability are discussed, modern concepts of the causes and mechanism of cold and hot cracking are set forth and ways of preventing them are suggested. Information about the properties of weld joints, welding materials, and conditions employed for welding in an atmosphere of protective gases, automatic welding under flux, electroslag, electron beam, and diffusion welding of high strength steels is included. Author

N72-29531# Arizona Univ., Tucson. Dept. of Aerospace and Mechanical Engineering.
INTERACTIONS AMONG THE VARIOUS PHENOMENA INVOLVED IN THE DESIGN OF DYNAMIC AND ROTARY MACHINERY AND THEIR EFFECTS ON RELIABILITY. VOLUME 1: BASIC REPORT OF REDUCED RESULTS AND UTILIZATION THEREOF Technical Report, 1 Feb. 1970 - 31 Aug. 1971
Dimitri Kececioglu and John C. Zipperer 31 Aug. 1971 192 p refs
(Contract N00014-67-A-0209-0002)
(AD-741219; TR-4) Avail: NTIS CSCL 13/9

The report continues the experimental research in material behavior. It contains descriptions of the calibration for the Wiedemann and Axial Fatigue Research Machines, the manufacture and inspection of specimens, the stress analysis of grooved specimens, the determination of economic optimum sample size for this research, the Kolmogorov-Smirnov Goodness-of-Fit Test which was added, and a discussion of the Weibull Distribution and its Confidence Limits for future application to this research. Material Properties are published for all four steels used in the research, i.e., AISI 1018, 1038, 4130, and 4340. Author (GRA)

N72-29532*# Little (Arthur D.), Inc., Cambridge, Mass.
PRODUCTION OF FIBERS BY A FLOATING ZONE FIBER DRAWING TECHNIQUE Final Report
J. S. Haggerty May 1972 65 p refs
(Contract NAS3-14328)
(NASA-CR-120948; ADL-73235) Avail: NTIS HC $5.25 CSCL 11D

A CO2 laser heated, floating zone fiber growth process was developed. The resulting Al2O3 fibers exhibited the high room temperature strengths for large diameter fibers as well as high specific creep rupture strengths observed at 1093 C and 1316 C (2000 F and 2400 F). Single crystal fibers of TiC and Y2O3 were also grown. An optical system was developed to focus four CO2 laser beams onto the surface of a feed rod permitting the formation of highly controllable molten zones. The optical system permitted energy densities and angle of incidence of the beams to be adjusted over wide ranges. This optical system was incorporated into a controlled atmosphere, fiber growth furnace. The two principal advantages of a CO2 laser heat source are that ambient atmospheres may be freely selected to optimize fiber properties and the laser has no inherent temperature limit, so extremely high melting point materials can be melted. Both advantages were demonstrated. Author

N72-29533*# Mobil Research and Development Corp., Paulsboro, N.J. Research Dept.
MICROFOG LUBRICANT APPLICATION SYSTEM FOR ADVANCED TURBINE ENGINE COMPONENTS, PHASE 2. TASKS 3, 4 AND 5: WETTABILITY AND HEAT TRANSFER OF MICROFOG JETS IMPINGING ON A HEATED ROTATING DISC, AND EVALUATION OF RECLASSIFYING NOZZLES AND A VORTEX MIST GENERATOR
J. Shim and S. J. Leonardi 1 Jun. 1972 207 p refs
(Contract NAS3-13207)
(NASA-CR-120843) Avail: NTIS HC $12.50 CSCL 11H

The wettabilities and heat transfer rates of microfog jets (oil-mist nozzle flows) impinging on a heated rotating disc were determined under an inert atmosphere of nitrogen at temperatures ranging from 600 to 800 F. The results are discussed in relation to the various factors involved in the microfog lubricant application systems. Two novel reclassifying nozzles and a vortex mist generator were also studied. Author

N72-29534# Scientific Translation Service, Ann Arbor, Mich.
AUTOMATIC ULTRASONIC TESTING OF AUSTENITIC STEEL ANGLE ASSEMBLIES
J. Marini and M. Roule Nov. 1970 40 p refs Transl. into ENGLISH from French report STA-NT-28 Prepared for ORNL Sponsored by AEC
(ORNL-TR-2592; STA-NT-28) Avail: NTIS

The feasibility of nondestructive ultrasonic testing of austenitic steel angle assemblies is discussed. The difficulties in using classical manual methods are described. The development of a control method which is suitable for automatic industrial applications is examined. Author

N72-29535# National Physical Lab., Teddington (England). Metrology Centre.
COMPARISON OF INTERNATIONAL ROCKWELL C AND VICKERS HV 30 HARDNESS SCALES DURING 1970 AND 1971
R. S. Marriner and Jill G. Wood May 1972 16 p
(NPL-MC-8) Avail: NTIS HC $3.00

The results of comparisons, made over a period of two years, of the standarized Rockwell C scale and Vickers HV30 scale are presented in graphical form. The hardness values in Rockwell C scale and Vickers HV30 scale on the same test blocks are discussed in relation to published hardness conversion tables. Author (ESRO)

N72-29536# Lockheed-Georgia Co., Marietta.
PROCEDURES FOR AVOIDING HEAT-TREAT CRACKING IN NICKEL-BASE SUPERALLOY WELDMENTS, PART 2 Final Technical Report, 4 Jan. - 31 Dec. 1971
Anthony T. DAnnessa Wright-Patterson AFB, Ohio AFML Feb. 1972 106 p refs
(Contract F33615-71-C-1135; AF Proj. 7351)
(AD-740591; LGR-ER-11272; AFML-TR-72-17) Avail: NTIS CSCL 13/5

The program concerned the development of procedures for avoiding post-weld heat-treat cracking in nickel-base superalloy weldments. Crack-susceptibility data were obtained for a number of studies including the effects of varying preweld solutioning treatments, effects of pre-weld cold work, effects of oxidation damage due to inadequate shielding during welding, evaluation of Rene' 41 powder metallurgy sheet material, procedure verifications, and the evaluation of varying pre-weld base metal

heat treatments for avoiding heat-treat cracking in Astroloy.
Author (GRA)

N72-29537# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BASES OF MATHEMATICAL METHODS IN THE THEORY OF METALWORKING UNDER PRESSURE
K. N. Shevchenko 10 Feb. 1972 406 p refs Transl. into ENGLISH of the publ. "Osnoy Mathematicheskikh Metodov v Teorii Obrabotki Metallov Davleniyen" 1970 p 1-351
(AF Proj. 7343)
(AD-741483; FTD-HC-23-326-71) Avail: NTIS CSCL 13/8

The book presents the bases of elastic and plastic theory, and gives solutions for several problems in this field, as applied to the theory of metalworking under pressure. The bases of two mathematical methods are considered: the method of characteristics, and direct methods of calculus of variations. Most of the problem solutions in the text are obtained by approximate mathematical methods. Some of the problems which are of great scientific and practical interest, but do not readily lend themselves to analytical solutions, are only formulated. GRA

N72-29538# Dayton Univ. Research Inst., Ohio.
MECHANICAL PROPERTIES OF 7049-T73 AND 7049-T76 ALUMINUM ALLOY EXTRUSIONS AT SEVERAL TEMPERATURES Final Report, Jun. 1970 - Jun. 1971
Raymond E. Jones Wright-Patterson AFB, Ohio AFML Feb. 1972 53 p
(Contract F33615-71-C-1054; AF Proj. 7381)
(AD-740878; UDRI-TR-71-38; AFML-TR-72-2) Avail: NTIS CSCL 13/8

The mechanical properties of (1) a 7049-T73 bar extrusion, (2) a 7049-T73 integrally stiffened extrusion and (3) a 7049-T76 bar extrusion were evaluated. The evaluation encompassed tensile, fracture toughness, axial fatigue, stress corrosion, and fatigue crack growth testing at several temperatures from -65 F to 500 F. Author (GRA)

N72-29539# Oceanics, Inc., Plainview, N.Y.
AN INVESTIGATION OF THE RELATIVE MOTIONS OF ACV LANDING CRAFT AND LARGE AMPHIBIOUS ASSAULT SHIPS Final Report
Paul Kaplan, Theodore P. Sargent, Alfred I. Raff, James Bentson, and Placido S. Bono Feb. 1972 108 p refs
(Contract N00014-71-C-0399)
(AD-741245; TR-72-90) Avail: NTIS CSCL 13/10

A mathematical analysis is used to determine the relative motions between an ACV landing craft and different assault ships under operating modes corresponding to well entry and alongside conditions associated with cargo transfer. The technique used is based on linear equations of motion, with probabilities of transfer determined from response data obtained via spectral analysis methods. The results provide guidance vs best operating speed of the assault ship and of the ACV; preferred heading relative to the waves; best orientation and position of the ACV relative to the assault ship; and limiting sea state conditions for safe and/or best operations to occur. GRA

N72-29540# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE ON THE INERTIA OF LUBRICATING FLUID ON THE LOAD-CARRYING CAPACITY OF THRUST SLIDE BEARINGS
A. S. Stolbovoi 10 Jan. 1972 10 p refs Transl. into ENGLISH from Gidravl. Mash. (Kiev), no. 3, 1969 p 98-102
(AF Proj. 7343)
(AD-740251; FTD-HT-23-1226-71) Avail: NTIS CSCL 11/8

The solution of the three-dimensional problem of hydrodynamic theory of lubrication is discussed considering inertial terms. The method of expansion in terms of the small parameter was used in the solution; the given Reynolds number was used as the small parameter. Using the computer and a finite difference method, the pressure distribution over the thrust cushion field was determined in the first approximation. GRA

N72-29541# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
CLASSIFICATION OF DEFICIENCIES AND SHORTCOMINGS Final Report on Test Operations Procedure
28 Mar. 1972 16 p refs
(AD-741799; TOP-1-1-012) Avail: NTIS CSCL 14/2

The report provides information for uniform classification of test incidents into categories as deficiencies and shortcomings.
Author (GRA)

N72-29542# Boeing Co., Seattle, Wash. Aerospace Group.
ON CONFIDENCE BOUNDS FOR SYSTEM RELIABILITY WHEN THE COMPONENTS HAVE EXPONENTIALLY DISTRIBUTED LIVES Final Report
Sam C. Saunders Mar. 1972 48 p refs
(Contract F44620-71-C-0114; AF Proj. 9749)
(AD-741833; D180-14820-1; AFOSR-72-1011TR) Avail: NTIS CSCL 14/4

One of the problems that has been of concern for a number of years is the following: Suppose that there exists a series system of m exponentially lived components and it is required that the system be qualified for service by demonstrating a reliability that equals, or exceeds, a specified value 1 - alpha, with a confidence level at least 1 - gamma. Here alpha and gamma are small. The paper addresses the question of how this can be demonstrated using only data on the reliability of the components, where the reliability design goals for each component must be apportioned, as well as the confidence levels at which the design goals must be met in order to satisfy the overall system reliability requirement. Author (GRA)

N72-29917* Aeronautical Research Labs., Melbourne (Australia).
A COMPARISON OF RELIABILITY AND CONVENTIONAL ESTIMATION OF SAFE FATIGUE LIFE AND SAFE INSPECTION INTERVALS
F. H. Hooke *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 667-680 refs (For availability see N72-29895 20-32)
CSCL 20K

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N72-29543*# TRW Systems Group, Redondo Beach, Calif.
PULSED DIFFERENTIAL HOLOGRAPHIC MEASUREMENTS OF VIBRATION MODES OF HIGH TEMPERATURE PANELS
D. A. Evensen, R. Aprahamian, and K. R. Overoye Washington NASA Jun. 1972 139 p refs
(Contract NAS1-10169)
(NASA-CR-2028; AM-71-7) Avail: NTIS HC $3.00 CSCL 20E

Holography is a lensless imaging technique which can be applied to measure static or dynamic displacements of structures. Conventional holography cannot be readily applied to measure vibration modes of high-temperature structures, due to difficulties caused by thermal convection currents. The present report discusses the use of pulsed differential holography, which is a technique for recording structural motions in the presence of random fluctuations such as turbulence. An analysis of the differential method is presented, and demonstration experiments were conducted using heated stainless steel plates. Vibration modes were successfully recorded for the heated plates at temperatures of 1000, 1600, and 2000 F. The technique appears promising for such future measurments as vibrations of

the space shuttle TPS panels or recording flutter of aeroelastic models in a wind-tunnel. Author

N72-29544# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
A COLOUR LASER BEAM IMAGE RECORDER FOR CANADA'S REMOTE SENSING PROGRAM
J. W. Locke [1972] 7 p
(Rept-1001151) Avail: NTIS HC $3.00

A large format (9 1/2 in. wide film) laser beam image recorder described. The instrument records images as large as 9 x 14 in. on color negative film using light beams from krypton and argon ion lasers. These beams are formed by a novel rotating optical element made holographically. Four film transports are employed for high throughput. The most significant feature of this instrument is its ability to correct for a wide class of errors that are often present in line scanner data. Author

N72-29545# Sandia Labs., Albuquerque, N.Mex.
FLAW DETECTION SENSITIVITY OF HOLOGRAPHIC INTERFEROMETRY ON CYLINDERS UNDER HOOP STRESS
C. G. Murphy, O. J. Burchett, and C. W. Matthews [1972] 8 p refs Sponsored by AEC
(SC-R-713450) Avail: NTIS

By employing constraints on cylinders under hoop stress, it is possible to make simplifications to the analysis of holographic interferometry (holometry) fringe systems, such that only a single view of a fringe system is necessary for determining radial deformations. This simplified analysis is described for radial deformation, and experimental procedures and geometry for applying the single view analysis are given. The strains found from both single view holometry and strain gauges are compared in order to demonstrate the accuracy of the method. To determine the sensitivity of holometry, a series of flaws were made in an aluminum cylinder. For each flaw size, radial deformations, induced by internal pressure changes, were measured using the single view holometry method. The results of this test series show that slowly varying flaws or voids of about 4% of wall thickness can be detected by holometry. Author

N72-29546# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
EXPERIMENTAL STUDY OF THE SHIFT OF LEVELS AND THE RAMAN EFFECT WITH ATOMS SUBJECTED TO THE NONRESONANT RADIATION OF A POWERFUL LASER Ph.D. Thesis - Paris Univ.
Peter Platz Oct. 1971 79 p refs In FRENCH
(EUR-CEA-FC-626) Avail: AEC Depository Libraries

The definitions and basic relations concerning the description of the atom and the quantized field are recalled. Perturbation theory is then used to treat the atom field system in terms of a single quantum system; in this way the line shifts are obtained. Integration of the Schroedinger equation in the secular approximation for a two-level atom provides the first pair of side components (n = 1) of the spectrum of the wave function of the perturbed atom. A new experimental method is described, which enables the atomic line shifts due to the interaction of the atom with the radiation of a powerful laser, to be studied. This technique is applied to the Hg atom. It is shown that these shift measurements provide a new method for measuring the oscillator strengths. A nonresonant Raman transition between two excited levels of a free atom is established for the first time. NSA

N72-29547# RAND Corp., Santa Monica, Calif.
SOVIET CHEMICAL LASER RESEARCH
Yuri Ksander Nov. 1971 173 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189)
(AD-740313; R-921/1/ARPA) Avail: NTIS CSCL 20/5

The report reviews recent Soviet open literature on chemical lasers, published mainly in January-October 1971. The report describes Soviet work on kinetics of chemical reactions, photodissociation lasers, photorecombination lasers, beam pumped lasers, and controlled chemical reactions. Author (GRA)

N72-29548# Aerospace Corp., El Segundo, Calif. Lab. Operations.
CLOSED-FORM SOLUTION TO RATE EQUATIONS FOR AN F PLUS H2 LASER OSCILLATOR Report for Sep. 1970 - Mar. 1971
George Emanuel and James S. Whittier 15 Apr. 1972 47 p refs
(Contract F04701-71-C-0172)
(AD-740562; TR-0172(2754)-1; SAMSO-TR-72-71) Avail: NTIS CSCL 20/5

Chemical lasers pumped by the reaction of atomic fluorine with molecular hydrogen emit power from rotation-vibration transitions of excited HF with upper levels as high as v-3. Collisional processes compete with stimulated emission for the energy of the excited HF. A simplified analysis is presented here for intensity, energy, and chemical efficiency of a class of such lasers. Results are obtained in closed form. A comparison with more exact computer solutions establishes the validity of the analysis despite its simplifications. A comprehensive parametric study examines the relative importance of initial conditions, optical cavity parameters, and rate coefficients for pumping and deactivation reactions. Author (GRA)

N72-29549# RAND Corp., Santa Monica, Calif.
SOVIET CHEMICAL LASER RESEARCH: PULSED LASERS, 1963-1970
Yuri Ksander Nov. 1971 56 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(AD-740312; R-921-ARPA) Avail: NTIS CSCL 20/5

The document reviews Soviet work on pulsed chemical lasers published in the open literature in 1963-1970. Whereas U.S. research combines the approaches of physics, quantum electrodynamics, and aerodynamics, Soviet laser research is heavily--and expertly--oriented to understanding the chemical reactions. They prefer pulsed to cw systems, concentrating on kinetics of vibrationally excited diatomic systems. The document studies gas lasers with discharge, photolytic, and other initiation and includes research on HN3-CO2 mixtures and studying means of controlling reaction rates by resonant coupling and selective heating. The report also proposes a laser based on photorecombination of atoms. Author (GRA)

N72-29550# Lockheed Missiles and Space Co., Palo Alto, Calif. Palo Alto Research Lab.
HIGH EFFICIENCY, SINGLE FREQUENCY LASER AND MODULATOR STUDY Quarterly Summary Technical Status Report
Robert C. Ohlmann, W. Culshaw, K. K. Chow, H. V. Hance, and W. B. Leonard 31 Dec. 1971 43 p refs
(Contract N00014-71-C-0049; ARPA Order 306)
(AD-740325; LMSC-N-JY-71-10; QTSR-5) Avail: NTIS CSCL 20/5

The general objective of this research and development program is to conduct investigations that will contribute to the development of an ultrawide-bandwidth laser communication system. The specific objectives are: (1) a study of laser communication system configurations, particularly modulation formats, that are most suitable for very high data rates up to 2 Gbit/sec; (2) research on high-efficiency, single-frequency Nd:YAG lasers as the transmitter source for such a communication system; and (3) research on an optical modulator with 2 GHz of rf bandwidth and good modulation efficiency. The primary emphasis of the program is on objectives (2) and (3). GRA

N72-29551# Avco-Everett Research Lab., Everett, Mass.
CARBON MONOXIDE LASER Quarterly Technical Status Report
Robert E. Center Apr. 1972 16 p refs
(Contract N00014-72-C-0030; ARPA Order 1807)
(AD-740767) Avail: NTIS CSCL 20/5

The main objective of this program is the investigation of pulsed electrical CO lasers to determine their potential scaling to large scale, high power operation. The program is based on the

application of the electron beam ionizer-sustainer concept to the vibrational excitation of CO with temperature controlled operation. GRA

N72-29552# United Aircraft Corp., East Hartford, Conn.
PICOSECOND PULSES AND YAG LASER SYSTEMS Semiannual Technical Report, 1 Aug. 1971 - 29 Feb. 1972
A. R. Clobes, William H. Glenn, Anthony J. DeMaria, and Robert E. Behringer 29 Feb. 1972 26 p refs
(Contract N00014-66-C-0344; ARPA Order-1806)
(AD-740230; L920479-33) Avail: NTIS CSCL 20/5

The report discusses the investigation of the frequency stability characteristic of single-frequency Nd YAG lasers. Technical results reported include the locking of a single-frequency Nd YAG laser to the bandpass of a high finesse Fabry-Perot interferometer, the unification of etalon thermal tuning of the laser for course frequency control, the construction of a second single-frequency laser, and the heterodyning of the two single-frequency YAG lasers at a variable frequency offset.
Author (GRA)

N72-29553# Hughes Research Labs., Malibu, Calif.
DAMAGE THRESHOLD STUDIES IN LASER CRYSTALS, SURFACE DAMAGE, PREVENTION OF SELF FOCUSING Semiannual Report
Concetto R. Giuliano, Robert W. Hellwarth, and Gerald R. Rickel Jan. 1972 47 p refs
(Contract F19628-69-C-0277; ARPA Order-1434)
(AD-740487; AFCRL-72-0071; SAR-5) Avail: NTIS CSCL 20/5

Initial experimental results on laser induced surface damage are discussed. The dependence of surface damage threshold on the distance between the focusing lens and sample indicates that surface damage for sapphire is a power density phenomenon. It is also pointed out that the exit surface damage threshold for sapphire is not connected with any nonlinear processes taking place deep within the bulk of the material, such as self-focusing. The relationship between surface plasmas and surface damage was also studied. The implications of these results are very important because they indicate that self-focusing can be avoided by choice of the appropriate beam shape. Theoretical considerations in this report have been concentrated mainly on a further pursuit of the question of whether optical breakdown does or does not involve an avalanche of hot electrons and also a consideration of means of measuring surface absorption at the faces of crystals so that the role of this absorption in surface damage may be assessed. Author (GRA)

N72-29554# Informatics, Inc., Rockville, Md.
BIBLIOGRAPHY OF SOVIET LASER DEVELOPMENTS Interim Report, Oct. - Dec. 1971
Stuart G. Hibben 9 Mar. 1972 82 p refs
(Contract F44620-70-C-0081; ARPA Order 1622)
(AD-740872; AFOSR-72-0960TR; IR-6) Avail: NTIS CSCL 20/5

The report covers the fourth quarter of 1971 with the major yield of information coming from the approximately 30 periodicals known to report the most advanced and interesting findings in Soviet laser technology. This as well as the previous reports covers the following topics: (1) laser research --solid state, liquid, gas and chemical lasers; UV components; nonlinear optics; spectroscopy of laser materials; short pulse generation; crystal growing; and general theory; (2) laser applications -- biological effects, communications, computer technology, holography, instrumentation, materials processing, and plasma generation.
Author (GRA)

N72-29555# General Telephone and Electronics Labs., Inc., Bayside, N.Y. Research Center.
GAS LASERS Annual Technical Report
A. Lempicki, S. Ahmed, and R. Pappalardo 31 Mar. 1972 78 p refs
(Contract N00014-71-C-0164; NR Proj. 016-304)
(AD-741238; GT/E-TR-72-841.1) Avail: NTIS CSCL 20/5

Electrical pulsed-discharges in molecular vapors have been investigated in a search for laser media with potentially high quantum-efficiency and emitting in the visible region of the spectrum. Models for obtaining population inversions are proposed in the case of mercuric halides, copper halides, and organic luminophors vapors. Optical gain has been detected from discharges in mercuric bromide. Evidence of gain has also been found in the case of copper-bromide discharges. It is also shown that gas buffered discharges in vapors of complex organic molecules provide intense, broad-band molecular emission.
Author (GRA)

N72-29556# Naval Research Lab., Washington, D.C.
A PERTURBATIVE TREATMENT OF THERMAL BLOOMING IN PULSED LASER BEAMS Interim Report
Alfred H. Aitken 18 Apr. 1972 34 p refs
(RR0110741)
(AD-741677; NRL-7414) Avail: NTIS CSCL 20/5

The atmospheric propagation of pulsed, focussed, laser beams is calculated. The beam intensity is obtained by solving the equation of geometric optics and the equation of energy conservation simultaneously using a perturbative scheme. In this way the modification on propagation due to change caused by the index of refraction absorption of energy from the beam itself is included in a linear approximation. The problem of calculating the index of refraction change in a quiescent atmosphere is formulated generally with detailed expressions, valid for all times, given for the case of a paraxial Gaussian beam. Formulas for beam intensity are given as graphical results presented for the on-axis intensity of a focussed Gaussian beam. Author (GRA)

N72-29557# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
PENNSYLVANIA-PRINCETON ARMY AVIONICS RESEARCH PROGRAM. MILLIMETER WAVE IMAGE CONVERSION TASK Final Report
Nabil H. Farhat, J. Bordogna, R. Goud, W. R. Guard, and J. Jastrzembski Nov. 1971 274 p refs
(Contract DA-28-043-AMC-02411E; DA Proj. 1H1-62202-A-219)
(AD-740228; Rept-72-10; ECOM-02411-25) Avail: NTIS CSCL 17/9

The results of an extensive study of millimeter wave image conversion and holography are presented. Experiments supported by theory and practical considerations show that the holographic approach to millimeter wave coherent imaging, despite its relative complexity, is superior to the direct imaging approach based on the imaging properties of millimeter wave lenses or other optics. In particular the results obtained with a holographic imaging system employing synchronous detection in conjunction with an electronically synthesized reference (ESR) to obtain a mapping of the phase distribution of the object wavefront over the hologram recording aperture are quite encouraging.
Author (GRA)

N72-29558# Stanford Research Inst., Menlo Park, Calif.
SRI DYE-LASER-RADAR OPERATION FOR SECEDE 2 Final Report
Roy A. Long Jan. 1972 30 p refs
(Contract F30602-71-C-0154; ARPA Order 1057; SRI Proj. 1001)
(AD-740489; RADC-TR-72-31) Avail: NTIS CSCL 17/6

A dye laser radar (lidar) was operated at a site near Wewahitchka, Florida during the SECEDE II test series, in an attempt to measure barium-ion-density variations within the ion cloud. If present at all, barium ions occur in the natural atmosphere at concentrations much too low to provide resonance backscatter for system-performance evaluation. Therefore, the system was operated before shipment at a 5896-A sodium resonance line and adequate system performance was obtained. The results of the tests are given. Author (GRA)

N72-29559# Radio Corp. of America, Camden, N.J. Advanced Technology Labs.
LASER DIODE PUMPED F-CENTER MASER *Final Report*, **1 Jul. 1971 - 29 Feb. 1972**
David J. Miller, Edward S. Sabisky, and Gary G. Weidner Mar. 1972 39 p refs
(Contract N00014-70-C-0216)
(AD-742094) Avail: NTIS CSCL 20/5

The feasibility of using F centers in potassium iodide as the paramagnetic material for an optically pumped maser was quantitatively studied. The work included selective pumping experiments with laser diodes, methods for producing F centers in KI, measurement of ground state properties and pumping characteristics, and a general evaluation of the suitability of F centers in KI for use in traveling wave masers. Author (GRA)

N72-29560# Defense Documentation Center, Alexandria, Va.
CO2 LASERS *Report Bibliography, Mar. 1966 - Nov. 1971*
May 1972 296 p refs
(AD-741800; DDC-TAS-72-31) Avail: NTIS CSCL 20/5

The references on Carbon Dioxide Lasers operating at 10.6 micron and certain other frequencies are compiled in this bibliography. The references deal with theoretical discussions, techniques of lasing, and their applications. Author (GRA)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N72-29561*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH-TEMPERATURE STRENGTH OF REFRACTORY-METAL WIRES AND CONSIDERATION FOR COMPOSITE APPLICATIONS
Donald W. Petrasek Washington Aug. 1972 40 p refs
(NASA-TN-D-6881; E-6795) Avail: NTIS HC $3.00 CSCL 11F

Tensile and stress-rupture tests were conducted on wires of W-Hf-C, W-Re-Hf-C, ASTAR 811C (a tantalum alloy), and B-88 (a columbium alloy) at room temperature, 1093 C (2000 F), and 1204 C (2200 F). Metallographic examinations were also made of the wire microstructure after testing. Ultimate tensile strength values up to 2170 meganewtons per square meter (314000 psi) at 1093 C (2000 F) and 1940 meganewtons per square meter (281 000 psi) at 1204 C (2200 F) were obtained for W-Re-Hf-C wire. The best strength values obtained for a 100-hour rupture life were, 1410 meganewtons per square meter (205 000 psi) at 1093 C (2000 F) and 910 meganewtons per square meter (132 000 psi) at 1240 C (2200 F) for W-Re-Hf-C wire. The properties obtained suggested that the wires studied showed promise as potential fiber reinforcement in the 1093 to 1204 C (2000 to 2200 F) temperature range. Author

N72-29562*# Battelle Memorial Inst., Columbus, Ohio.
THERMAL AND MECHANICAL TREATMENTS FOR NICKEL AND SOME NICKEL-BASE ALLOYS: EFFECTS ON MECHANICAL PROPERTIES
A. M. Hall and V. F. Beuhring Washington NASA 1972 110 p refs Sponsored by NASA
(NASA-SP-5106; LC-75-177269) Avail: NTIS SOD $1.00 CSCL 11F

This report deals with heat treating and working nickel and nickel-base alloys, and with the effects of these operations on the mechanical properties of the materials. The subjects covered are annealing, solution treating, stress relieving, stress equalizing, age hardening, hot working, cold working, combinations of working and heat treating (often referred to as thermomechanical treating), and properties of the materials at various temperatures. The equipment and procedures used in working the materials are discussed, along with the common problems that may be encountered and the precautions and corrective measures that are available. Author

N72-29563# National Materials Advisory Board, Washington, D.C. Committee on the Technical Aspects of Critical and Strategic Materials.
MUTUAL SUBSTITUTABILITY OF ALUMINUM AND COPPER
Apr. 1972 205 p refs Supported in part by Bureau of Mines
(Contract GS-OO-DS-(p)-94008)
(NMAB-286) Avail: NTIS HC $12.25

A practical procedure is presented for determining the mutual substitutability of aluminum and copper. The incentive to substitute is largely economic, rather than technical. A change in material calls for an understanding of the demands of the design and the operation of the part, a careful study of the characteristics of the alternatives, and the selection of appropriate manufacturing processes. The mutual substitutability of copper and aluminum is discussed in applications, such as electrical conductors, heat exchangers, corrosion, alloying, and coatings. Estimating the total cost of substitution requires considering all the system changes, engineering costs, maintenance and capital expenses, in addition to comparing the prices of the materials involved. Author

N72-29564*# General Electric Co., Cincinnati, Ohio.
RENE 95 BRAZED JOINT METALLURGICAL PROGRAM *Final Report*
C. Gay, J. Givens, S. Mastrorroco, and A. Sterman [1972] 97 p refs
(Contract NAS2-6056)
(NASA-CR-120957; TM-72-326) Avail: NTIS HC $7.00 CSCL 11F

This metallurgical program was specifically conducted for the establishment of material properties required for the design of the LF460 fan. The LF460 lift fan is an advanced 18:1 high thrust to weight single stage design. It has a turbine attached to the outer flowpath of the fan blade tip which minimizes the axial depth of the fan. Advanced lightweight attachment designs are employed in this concept to achieve minimum mass polar moments of inertia which are required for good aircraft flight response control. The design features which are unique to this advanced LF460 lift fan are the 0.010 inch thin Udimet 700 alloy integral tip turbine design, minimum weight braze attachment of the turbine to the fan blade, and the high strength and elevated temperature capability of the Rene'95 alloy for the fan blade. The data presented in this report show that the LF460 fan rotor design is feasible and that the design stresses and margins of safety were more than adequate. Prior to any production application, however, additional stress rupture/shear lap joints should be run in order to establish a firm 1200 F stress rupture curve for the CM50 braze metal. Author

N72-29565*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF OXIDATION RESISTANT NONMETALLIC MATERIALS AT 1204 C (2200 F) IN A MACH 1 BURNER
William A. Sanders and Hubert B. Probst Washington Aug. 1972 27 p refs
(NASA-TN-D-6890; E-6918) Avail: NTIS HC $3.00 CSCL 11F

Specimens of 23 oxidation resistant, nonmetallic, refractory materials were systematically exposed in a high gas velocity burner to simulate a turbine engine environment. Isothermal and cyclic tests were conducted at a specimen temperature of 2200 F which resulted from exposure to Mach 1 or Mach 0.5 hot gas streams. Specimen behavior was judged on the basis of failure mode, appearance, and weight change. SiC and Si3N4 exhibited the most promising behavior surviving all exposures including Mach 1 for 120 cycles (10 hr). Major failure modes identified for other materials were thermal shock, thermal fatigue, and mechanical failure due to gas loading. Author

N72-29566# Bureau of Mines, Rolla, Mo. Metallurgy Research Center.
LOWERING THE TIN CONTENT OF SECONDARY LEADED TIN-BRONZE BY REPLACEMENT WITH LEAD OR ZINC
E. R. Cole, L. W. Higley, and J. L. Holman 1972 15 p refs
(BM-RI-7659) Avail: NTIS HC $3.00

Laboratory heats of an 80 percent copper high-leaded tin-bronze alloy, similar to Brass and Bronze Ingot Institute (BBII) alloy 3A, were made with reduced tin content to determine whether an alloy comparable to BBII alloy 3A could be produced using less tin to aid in conserving this strategic metal. The tin content was lowered from 10 percent to 8 percent and 5 percent (nominal values), respectively, and the reduction in tin was offset by either increasing the lead content or adding zinc. Mechanical properties, machinability, and corrosion characteristics of the resultant alloys were investigated, and the mechanical properties were compared with BBII typical values and American Society for Testing Materials (ASTM) minimums for high leaded tin-bronze alloy. Results indicate that the tin content of this alloy could be reduced approximately 1 percent (difference between the 8.4 percent actual tin composition obtained and the 9.3 percent BBII minimum) without seriously affecting the desired properties. Results also show the tin content could be reduced without significantly increasing the chances of rejects for mechanical property failures, which might result from normal variations in the casting process. Author

N72-29567# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
INFRARED REFLECTIVITY OF CHROMIUM AND CHROMIUM-ALUMINUM ALLOYS Ph.D. Thesis
Michael Acton Lind Apr. 1972 110 p refs
(Contract W-7405-eng-82)
(IS-T-502) Avail: NTIS

In Cr the absorption corresponding to the temperature dependent energy gap at about 0.21 eV, which is caused by the incommensurate magnetic ordering, was observed and found to agree with the data of other authors. Evidence is also given to support the assumption of an indirect transition of approximately 0.45 eV across two energy gaps in Cr and the most dilute alloys. Alloys with Al concentrations of less than 1.02% are found to have reflectivities similar to pure Cr with the absorptions at 0.12 eV and 0.45 eV still present and unshifted in energy contrary to the predictions of a rigid band model. The alloys with 1.41% Al and 1.91% Al show no temperature dependent structure that can be associated with the magnetic ordering. Those alloys with Al concentrations between 1.91% and 6.36% are found to have an absorption at 0.35 eV which was observed in other Cr alloys. This absorption is found to be weaker in the Cr-Al alloys than in other Cr alloy systems. The semiconductor-like alloys with 19.0 and 27.0% Al are found to have absorptions at 0.3 eV and 0.041 eV corresponding to the energy gaps due to the commensurate magnetic ordering and the semiconductor-like structure respectively. Author

N72-29568# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
SILICONIZING STEEL IN MOLTEN MAGNESIUM ALLOY MEDIA Ph.D. Thesis
Ziaul Haq Usmani Apr. 1972 94 p refs
(Contract W-7405-eng-82)
(IS-T-516) Avail: NTIS

An investigation of the siliconizing of Armco iron or low-carbon steel was completed. Iron specimens were immersed in liquid metal transfer media of magnesium, Mg-50 wt % Zn, and Mg-67 wt % Pb containing five to seven wt % silicon. Contrary to expectation it was found that the silicon diffusion band composition was not dependent upon which of the three transfer media was employed or to the silicon content of the medium if the amount present was equal to or greater than about 1.0 wt %. The silicon content of the diffusion band on the iron ranged in composition from 14 to about 9 wt % silicon. X-ray diffraction data showed that the band was primarily the Fe3Si phase of the Fe-Si system. Author

N72-29569# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
PHYSICAL PROPERTIES OF ZIRCONIUM AND ITS ALLOYS
T. Pav and I. Saxl 1971 119 p refs In CZECH; ENGLISH summary
(UJV-2708-M) Avail: AEC Depository Libraries

The selected physical properties (density, thermal, electric and magnetic properties, elastic constants, and internal friction) of zirconium and its alloys are reviewed. The literature survey covers the published data up to 1971. A total of 111 references is given. Author (NSA)

N72-29570# Ministry of Defence, London (England).
FACTORS AFFECTING THE ELECTRODEPOSITION OF PAINTS ON AIRCRAFT ALLOYS
G. A. Dunn London Min. of Defence Aug. 1971 47 p
(Contract KS/1/0503/C.B.43(a)2)
(D-MAT/AV-175) Avail: NTIS HC $4.50

Experiments concerned with the electropainting of aluminum alloys and magnesium alloys are summarized. It is shown that, in the case of aluminum, anodizing is a precursor to paint deposition. A system is described whereby aluminum alloys may be electropainted with a low (100 C) temperature curing system which contains a chromate pigment, and which imparts good salt spray resistance. The advantage of the system in penetrating crevices in complex structures and assemblies is demonstrated. Methods are described for electropainting magnesium alloys to provide a finish with a measure of salt spray resistance and for electropainting relatively deep holes in magnesium castings with a paint layer of controllable thickness. Author (ESRO)

N72-29571# Drexel Inst. of Tech., Philadelphia, Pa. Dept. of Metallurgical Engineering.
FIELD-AIDED ZONE REFINING OF REFRACTORY METALS AND IRON Final Report, 1 Sep. 1967 - 31 Aug. 1971
D. Robert Hay and Prakash D. Parikh Jan. 1972 187 p refs
(Contract DA-ARO(D)-31-124-G933)
(AD-740206; AROD-6945-4-MC) Avail: NTIS CSCL 11/6

The report describes in detail recent work on studies of plastic deformation of body-centered cubic transition metals in the microyield regime and the vicinity of yielding. Author (GRA)

N72-29572# Naval Research Lab., Washington, D.C.
STRESS-CORROSION CRACKING OF HIGH-STRENGTH STEELS AND TITANIUM ALLOYS Summary Report
Ralph W. Judy, Jr. and Robert J. Goode 13 Mar. 1972 32 p refs
(AD-740749; NRL-7371) Avail: NTIS CSCL 11/6

One of the major problems of metal structures in the seawater environment is the growth of flaws by the stress-corrosion-cracking (SCC) mechanism. Environmental effects on the integrity of the structure are related both to SCC processes and to the inherent tolerance of the material for flaws at regions of high stresses. The Ratio Analysis Diagram (RAD) provides translations of fracture resistance properties of metals to expected structural performance; the RAD has been modified to include analyses of the effects of SCC. The significance of section-size effects on the results of SCC tests based on linear-elastic analysis methods and expected structural behavior are included on the modified diagram, which is called the Dual-SCC RAD. Examples of several current high-strength steels and titanium alloys are referenced to the Dual-SCC RAD to illustrate its use. Author (GRA)

N72-29573# Naval Air Development Center, Johnsville, Pa. Aero Materials Dept.
HYDROGEN STRESS CRACKING OF HIGH STRENGTH STEELS Final Report
Walter Beck, Edward J. Jankowsky, and Philip Fischer 23 Dec. 1971 219 p refs
(AD-740111; NADC-MA-7140) Avail: NTIS CSCL 11/6

The report deals with hydrogen induced embrittlement and

stress cracking of high strength steel parts. Selected mechanical methods involving the different types of test specimens for the measurement of hydrogen embrittlement or delayed failure, and relevant methods for the quantitative determination of hydrogen extracted from embrittlement susceptible specimens are presented. Embrittlement resulting from pickling and chemical milling are considered. In addition, case studies of failures are included dealing with electroplated steel aircraft components, weldments, the petroleum industry, parts installed in boilers, pressurized water reactors, pressurized hydrogenation units, and parts cathodically protected. Different techniques for restoring ductility or preventing delayed failure are also included. A new thermodynamic approach to the interpretation of the hydrogen embrittlement phenomenon is offered and a number of variables which control the generation or minimization of hydrogen embrittlement is analyzed and discussed in the light of electrochemical kinetics. Author (GRA)

N72-29574# North American Rockwell Corp., Los Angeles, Calif.
A STUDY OF DISLOCATION, HYDROGEN INTERACTION IN ALPHA TITANIUM VIA INTERNAL FRICTION MEASUREMENTS
P. P. Tung and A. W. Sommer Feb. 1972 40 p refs
(Contract N00014-67-C-0439)
(AD-740324; NA-72-305; TR-7) Avail: NTIS CSCL 11/6

A hydrogen-dislocation interaction in alpha titanium was studied via internal friction measurements of a damping peak in the temperature range 200 to 500 K. The peak centers around 390 K at 10 megahertz. Author (GRA)

N72-29575# Watervliet Arsenal, N.Y. R and E Labs.
RHENIUM ALLOYS: IRON GROUP METALS, ELECTRODEPOSITION AND PROPERTIES M.S. Thesis
V. Peter Greco Oct. 1971 74 p refs
(AD-741362; WVT-7150) Avail: NTIS CSCL 11/6

The electrodeposition of thick deposits of rhenium co-deposited with the iron group metals (binary systems) from various electrolytes has been investigated. Microstructures of some of the alloys are shown and some of their properties have been evaluated and discussed. The behavior of the alloys (15-45 weight per cent Re) after heat treatment at temperatures ranging from 600-1800 F have been studied and the microstructural and microhardness changes are presented. Crystallography of the Co-Re system before and after heat treatment is also discussed. The effects of inert sub-micron sized dispersoids of Al2O3 on the microstructure and properties of Co-Re alloy coatings are presented. Author (GRA)

N72-29576# California Univ., Los Angeles. Dept. of Materials.
BRITTLE FRACTURE OF SOLIDS Final Report, 1 May 1971 - 30 Apr. 1972
M. H. Kamdar and K. Ono Apr. 1972 7 p refs
(Grant DA-ARO(D)-31-124-71-G124; DA Proj. 200-61102-B-32D)
(AD-740179; AROD-10048-2-MC) Avail: NTIS CSCL 11/6

In developing a criterion for complete fracture of a solid, it is considered necessary to decide whether a crack, once nucleated, will spread throughout the solid, and this problem has been the salient part of more important theories of brittle fracture. For solids in which a crack initiates and propagates in the same, Stroh and Smith have derived from theoretical considerations a condition for nucleation controlled fracture. Author (GRA)

N72-29577# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CUMULATION OF CREEP STRAINS AND DEFECTS IN AN Al-Mg-Si ALLOY UNDER A SINGLE LOAD VIBRATION
Anatoliusz Jakowluk 8 Feb. 1972 20 p refs Transl. into ENGLISH from Archiwum Bodowy Maszyn (Poland), v. 17, no. 4, 1970 p 621-632
(AD-742412; FTD-HC-23-1509-71) Avail: NTIS CSCL 11/6

The influence of overload and underload on the cumulation of creep for the determination of the limit strain and the cumulation of defects under creep conditions are analyzed. Overload produces considerable strain hardening, which decreases with increasing limit strain. Underload causes insignificant softening decreasing with increasing limit strain. The cumulation of defects under creep conditions is quasi linear. This means that at such a strain level there is neither strain hardening nor softening. Author (GRA)

N72-29578# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTROMAGNETIC TEEMING AND TREATMENT OF LIQUID METAL
L. A. Verte 28 Feb. 1972 224 p refs Transl. into ENGLISH of "Electromagnitnaya Razlivka Obrabotka Zhidkogo Metalla" 1967 p 1-206
(AD-742363; FTD-HC-23-365-71) Avail: NTIS CSCL 11/6

The report deals with application of an electromagnetic field to control the teeming of liquid metal in casting and metallurgical operations, and the development of new processes of liquid metal treatment and its purification from gases, nonmetallic inclusions and impurities. Procedures for dosing liquid metal, automatically filling flasks on casting conveyors, filling molds under pressure, etc., are also described. Technological applications of electromagnetic engineering are preceded by a review of various electromagnetic devices, which have an electromagnetic effect on metallic melts with no contact. Author (GRA)

N72-29579# Battelle Memorial Inst., Columbus, Ohio.
DYNAMIC PROPERTIES OF SUPERALLOYS AT ELEVATED TEMPERATURES Final Report
Donald R. Ireland Rock Island, Ill. Army Weapons Command Feb. 1972 119 p refs
(Contract DAAF03-71-C-0016; DA Proj. 1W5-62604-A-607)
(AD-741378; AMSWE-RE-TR-71-75) Avail: NTIS CSCL 11/6

The dynamic response properties of Cr-Mo-V, Pyromet X-15, 22-4-9, CG-27, and A286 alloys at temperatures from 72 through 1500 F were determined. Both standard Charpy and fatigue precracked specimens were used. The analyses included: (1) characterization of the types of fracture from the appearance of the load-deflection curves, (2) examinations of the appearance of the fracture surfaces, (3) measurement of the various load, deflection, and energy parameters from the load-deflection record, and (4) evaluation of the various calculated energy, strength, and toughness parameters. Author (GRA)

N72-29580# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WEAR RESISTANCE AND COEFFICIENT OF FRICTION OF CAST SELF-FLUXING SOLID ALLOYS
G. M. Yakovlev and N. P. Gaidukevich 14 Mar. 1972 12 p Transl. into ENGLISH from Progr. Tekhnol. Mashinostr. (Minsk), no. 1, 1970 p 11-17
(AF Proj. 7343)
(AD-740401; FTD-HC-23-2112-71) Avail: NTIS CSCL 11/6

It is shown that the wear resistance of self-fluxing alloys increases with the load in dry friction or when lubricants containing abrasive particles are used. An alloy couple has the lowest friction under high loads. Parts with a self-fluxing solid alloy surface have a wear resistance at least 4 times greater than standard production parts. GRA

N72-29581# Army Foreign Science and Technology Center, Charlottesville, Va.
DEFORMATION PROCESSES IN METALS AND ALLOYS
N. V. Ageev 22 Mar. 1972 324 p refs Transl. into ENGLISH of the book "Protsessy Formoizmeneniya Metallov i splavov" Moscow, Nauka Publishing House, 1971 200 p
(AD-742185; FSTC-HT-23-1144-72) Avail: NTIS CSCL 13/8

The collection contains several investigations on the plastic

deformation of metals which have theoretical and technological significance. The overall scientific results of I. M. Pavlov's research of recent times are reflected in his articles on the dialectic method, the physical essence of mechanical and mathematical concepts, and a new understanding of the processes of plastic deformation in vacuum. This collection also examines the influences of chemical composition and deformation conditions (temperature, rate, and degree of deformation) on the mechanical properties of several metals and alloys, questions of method concerned with the distribution of stress in billets of different configuration during compression in flat and profiled blocks, and problems of plastic deformation of tungsten, molybdenum, and alloys on a nickel base. GRA

N72-29582# Army Foreign Science and Technology Center, Charlottesville, Va.
MODERN PROBLEMS OF POWER METALLURGY
I. M. Fedorchenko, V. V. Skorokhod, I. D. Radomyselskii, G. A. Meerson, and O. V. Roman 21 Mar. 1972 424 p refs Transl. into ENGLISH of the Publ. "Sovremennyye Problemy Poroshkovoy Metallurgi" Kiev, Naukova Dumka, 1970 343 p
(AD-742159; FSTC-HT-23-1026-72) Avail: NTIS CSCL 11/6

The articles in this collection cover all aspects of the design, production and testing of powder metallurgy products. Particular attention is given to highly refractory powder products, as well as products used as fuel for nuclear reactors and in the space industry. GRA

N72-29583# Brown Univ., Providence, R.I.
THERMOMECHNICAL PROCESSING BETA TITANIUM Final Report, 20 Jan. 1971 - 20 Jan. 1972
Donald H. Avery, John B. W. Greene, and Raymond M. Wallace Watertown, Mass. Army Mater. and Mech. Res. Center Feb. 1972 32 p refs
(Contract DAAG46-71-C-0037; DA Proj. 1B5-64603-D-385)
(AD-742256; AMMRC-CTR-72-2) Avail: NTIS CSCL 11/6

Thermomechanical processing of the beta titanium alloy TS-6 (Ti: 10Cr, 7V, 3.5Mo, 3 Al) has been investigated. Mechanical properties, hardness and aging kinetics increase with increasing cold-reduction of metastable beta. Strengths in excess of 270,000 psi with 12 to 15% reduction in area have been achieved. Hardnesses of R(c)55 have been obtained with long-time aging. Transmission electron microscopy and selected-area diffraction were used to characterize the structure associated with these properties. Author (GRA)

N72-29584# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANISOTROPY AND TENSION TEXTURE OF 99.5 PERCENT ALUMINUM SPECIMENS
Jan Kusnierz and Zdzislaw Jasienski 8 Feb. 1972 30 p refs Transl. into ENGLISH from Archiwum Hutnictwa (Poland), v. 14, no. 4, 1969 p 345-370
(AD-742411; FTD-HC-23-1508-71) Avail: NTIS CSCL 11/6

A quantitative determination of anisotropy of rolled Al sheet is described with particular reference to the influence of the strain texture of the test specimens on the anisotropy coefficient, defined as the deformation ratio at two directions at right angles to each other. The formation of the texture due to straining in the tests was examined by pole figures. Author (GRA)

N72-29585# Rensselaer Polytechnic Inst., Troy, N.Y. Materials Div.
CORROSION FATIGUE OF METALS AND ALLOYS
David J. Duquette 10 May 1972 121 p refs
(Contract N00014-67-A-0117-0012; NR Proj. 036-093)
(AD-742461; TR-1) Avail: NTIS CSCL 11/6

The review presents a detailed summary of the current understanding of the phenomenon of corrosion fatigue in gaseous and in aqueous environments. The effects of gaseous environments at low and at elevated temperatures and the mechanisms which govern fatigue crack initiation and propagation in the presence and in the absence of reaction films are discussed. The effects of aggressive aqueous solutions on fatigue crack initiation and propagation in ferrous and non ferrous alloys, and the effectiveness of protective measures are treated in detail and a critical review of previously proposed and currently accepted models is presented. Author (GRA)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N72-29586*# MSC White Sands Test Facility, N.Mex.
REACTION PROPAGATION TEST. EVALUATION OF THE BEHAVIOR OF NONMETALLIC MATERIALS IN HYDROGEN
I. D. Smith 24 Mar. 1972 112 p Original contains color illustrations
(NASA-TM-X-68570; TR-196-001) Avail: NTIS HC $7.75 CSCL 11D

Results of tests conducted to evaluate the behavior of nonmetallic materials in hydrogen are described. The reaction propagation test simulates the conditions resulting from the interaction of an electrical wire in an overload condition in contract with a material in the test medium. The test is designed to evaluate the behavior of a material subjected to an energy input (usually heat) sufficient to cause a reaction which propagates to consume larger quantities of the material. Ten nonmetallic materials were evaluated to establish baseline data on the behavior of nonmetallic materials in hydrogen and to characterize, on an initial basis, one mode of material failure considered to be a factor pertinent to the safe use of a material in hydrogen.
Author

N72-29587*# Utah Univ., Salt Lake City. Dept. of Mechanical Engineering.
FRACTURE BEHAVIOR IN NYLON 6 FIBERS Ph.D. Thesis
Ben Ashton Lloyd Jun. 1972 167 p refs
(Grants NGL-45-003-029)
(NASA-CR-127777) Avail: NTIS HC $10.50 CSCL 11D

Electron paramagnetic resonance (EPR) techniques are used to determine the number of free radicals produced during deformation leading to fracture of nylon 6 fibers. A reaction rate molecular model is proposed to explain some of the deformation and bond rupture behavior leading to fracture. High-strength polymer fibers are assumed to consist of a sandwich structure of disordered and ordered regions along the fiber axis. In the disordered or critical flaw regions, tie chains connecting the ordered or crystalline block regions are assumed to have a statistical distribution in length. These chains are, therefore, subjected to different stresses. The effective length distribution was determined by EPR. The probability of bond rupture was assumed to be controlled by reaction-rate theory with a stress-aided activation energy and behavior of various loadings determined by numerical techniques. The model is successfully correlated with experimental stress, strain, and bond rupture results for creep, constant rate loadings, cyclic stress, stress relaxation and step strain tests at room temperature. Author

N72-29588*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
IMPROVEMENT OF REUSABLE SURFACE INSULATION MATERIAL Final Report
1 Mar. 1972 194 p refs
(Contract NAS9-12137)
(NASA-CR-115712; LMSC-D266204) Avail: NTIS HC $11.75 CSCL 11D

The results are presented of a program to improve the

reusable surface insulation (RSI) system through the improvement of the LI-1500 material properties and the simplification of the RSI system. The improvements made include: 2500 F-capability RSI systems, water-impervious surface coatings, establishment of a high-emittance coating constituent, development of a secondary water-reduction system, and achievement of a lower density (9 pcf) RSI material. Author

N72-29589# Advisory Group for Aerospace Research and Development, Paris (France).
COMPOSITE MATERIALS
B. Walter Rosen May 1972 125 p refs
(AGARD-LS-55) Avail: NTIS HC $8.25

The material reported was assembled to support a lecture series presented in Oslo (Norway), Lyngby (Denmark) and Lisbon (Portugal) in June 1972. The objective of the lectures was to present the modern composites concept, a review of materials for advanced composites (fibers, reinforced plastics, metal matrix composites). Considerations in the application of advanced composites and airframe application are covered. For individual titles, see N72-29590 through N72-29596.

N72-29590 Materials Sciences Corp., Blue Bell, Pa.
DESIGN OF COMPOSITE MATERIALS
Walter Rosen *In* AGARD Composite Mat. May 1972 22 p refs (For availability see N72-29589 20-18)

Studies of the relationships between the effective properties of fiber composite materials and the mechanical and geometric properties of their constituents are reviewed. The aims of such studies are, first, to provide the ability to analyze the performance of structures utilizing these heterogeneous materials, and second, to provide guidelines for the development of improved materials. The rationale for designing a material to suit the application is described. The feasibility of accomplishing this aim through the use of high stiffness and high strength filamentary materials is discussed. It is emphasized that the design cycle with composites involves many more steps than the equivalent metallic structural design process. The relationship is developed governing the thermomechanical properties of composites. The importance of heterogeneity and anisotropy are treated. Theoretical results are presented for composite elastic moduli, thermal expansion coefficients, thermal conductivities, and specific heats. Results are presented in a form easily usable for parametric study of candidate materials during the preliminary design phase. The status is discussed of the understanding of the tensile, compressive and shear strengths of unidirectional composites. The definition of the mode of failure is emphasized. Author

N72-29591 Rensselaer Polytechnic Inst., Troy, N.Y. Materials Div.
FIBER AND MATRIX MATERIALS FOR ADVANCED COMPOSITES
R. J. Diefendorf *In* AGARD Composite Mat. May 1972 20 p refs (For availability see N72-29589 20-18)

Composite materials provide a solution for the engineering use of high specific strength-high specific modulus, but brittle materials. These brittle materials are used as fibrous reinforcement to provide strength and stiffness in the composite. The fundamental principles for selecting the reinforcements are described, as well as the concepts used to form these materials into high strength filament. Detailed information on the preparation, structure and properties of boron, carbon and organic filament are presented. Matrix materials, which are used to transfer stress to the fiber and also prevent brittle failure, are discussed in less detail. The techniques for combining filaments and matrix into prepreg or other preforms, and the fabrication into structure are considered. Finally, the mechanical properties of composites based on boron, carbon, and organic fibers are presented. Author

N72-29592 General Dynamics/Fort Worth, Tex.
COMPOSITES IN THE STRUCTURAL DESIGN PROCESS
M. E. Waddoups *In* AGARD Composite Mat. May 1972 13 p refs (For availability see N72-29589 20-18)

The use of advanced composites as a primary structural material for aircraft structures has required alteration of the characterization and design process. Specific departures from conventional lightweight metal design practices have resulted because of the fabrication and process control characteristics, the failure characteristics of the material, and the additional structural design variables. Each of these subject areas with the attendant impact of composite materials on design practice are reviewed. Case examples for actual prototype hardware are presented. Author

N72-29593 National Physical Lab., Teddington (England). Div. of Materials Applications.
EXPERIMENTAL METHODS FOR COMPOSITE MATERIALS
B. E. Read and G. D. Dean *In* AGARD Composite Mat. May 1972 28 p refs (For availability see N72-29589 20-18)

A wide range of techniques is discussed for measuring the elastic, viscoelastic, ultimate strength, thermal and electrical properties of fiber reinforced composites. Main emphasis is given to the determination of the basic properties of unidirectionally reinforced composites and, for this purpose, the mechanical test samples considered are mainly in the form of rectangular bars. However, some consideration is given to methods involving honeycomb sandwich structures, circular rods, plates, rings and cylinders. For determining the state Youngs moduli and Poissons ratios, tensile and compressive tests are considered in addition to flexure methods (cantilever, 3-point and 4-point) and also the honeycomb sandwich technique. Methods for measuring the shear moduli include both torsion and off-axis tensile tests. Comparative elastic data obtained by these methods are collected and discussed for unidirectional silica fiber-epoxy, carbon fiber-epoxy, boron fiber-epoxy and boron fiber-aluminum composites. Creep and stress relaxation methods are outlined for studying time-dependent viscoelastic behaviour and results illustrated for nylon-rubber and boron-epoxy composites. Several dynamic tests are described including the low frequency forced nonresonance, torsion pendulum, audiofrequency resonance and ultrasonic pulse techniques. Dynamic elastic constants and damping factors are illustrated for carbon fiber-epoxy composites as a function of frequency and fiber volume fraction. Methods are assessed for determining the tensile, compressive, flexural and shear strength, fracture energy and fatigue life, and selected data are illustrated for some carbon fiber, boron fiber and glass fiber composites. Techniques for measuring the thermal expansion coefficient, thermal conductivity, heat capacity, electrical resistivity, dielectric constant and loss are outlined, and some results presented for unidirectional carbon fiber composites. Brief mention is made of magnetoresistive and thermomagnetic data obtained on a composite formed by the unidirectional solidification of an eutectic InSb-NiSb mixture. Author

N72-29594 General Dynamics/Fort Worth, Tex.
AUTOMATED DESIGN AND FUTURE DESIGN TRENDS
M. E. Waddoups *In* AGARD Composite Mat. May 1972 10 p refs (For availability see N72-29589 20-18)

Examples of the new class of key composites-related optimization problems are presented accompanied by illustrations of the application of modern optimization methods to composite design problems. Author

N72-29595 British Aircraft Corp., Warton (England). Military Aircraft Div.
GENERAL CONSIDERATIONS IN THE APPLICATIONS OF ADVANCED COMPOSITES
I. C. Taig *In* AGARD Composite Mat. May 1972 14 p refs (For availability see N72-29589 20-18)

The characteristics of advanced composites are compared with those of conventional airframe materials. It is shown that many considerations other than conventional mechanical properties and fabrication technology influence the selection and realization of effective applications of composites. Particular attention is given to the assessment of cost effectiveness; to the

achievement of integrity in a broad sense, including protection against adverse environmental effects and to some practical aspects of producibility. Trends in material and manufacturing costs are presented to show that in the airframe industry, most parts of the structure could benefit from the extensive use of composites in the next ten years. Expansion and redirection of the research and development effort will be needed to exploit the economic potential of the materials. Author

N72-29596 British Aircraft Corp., Warton (England). Military Aircraft Div.
AIRFRAME APPLICATIONS OF ADVANCED COMPOSITES
I. C. Taig *In* AGARD Composite Mat. May 1972 12 p refs (For availability see N72-29589 20-18)

A wide variety of primary and secondary structural applications of advanced composites are presented. It illustrates, using actual or projected examples, the progressive introduction into service of components of increasing complexity and cost effectiveness. All previously unpublished information relates to carbon fiber epoxy composites under development in the U.K., but to broaden the picture, the coverage also includes boron/epoxy, carbon/epoxy and, to a lesser extent, boron/aluminum applications in the U.S.A. The range of components covered includes: composite reinforced metal members; sandwich panel structures such as doors, floors and control surfaces; rod and the tube members, box structures such as tail surfaces and wings: frames, bulkheads and fuselage shell structures. Particular emphasis is given to the design principles and practical features embodied in each application illustrating as far as possible the general considerations of the previous paper. Where information is available, mass savings and cost effectiveness data are quoted and comments on the operating environment and experience in service are included. Author

N72-29597*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADHESION AND TRANSFER OF POLYTETRAFLUOROETHYLENE TO TUNGSTEN STUDIED BY FIELD ION MICROSCOPY
William A. Brainard and Donald H. Buckley Washington Aug. 1972 21 p refs
(NASA-TN-D-6887; E-6919) Avail: NTIS HC $3.00 CSCL 11A

Mechanical contacts between polytetrafluoroethylene (PTFE) and tungsten field ion tips were made in situ in the field ion microscope. Both load and force of adhesion were measured for varying contact times and for clean and contaminated tungsten tips. Strong adhesion between the PTFE and clean tungsten was observed at contact times greater than 2.5 min (forces of adhesion were greater than three times the load). For times less than 2.5 min, the force of adhesion was immeasurably small. The increase in adhesion with contact time after 2.5 min can be attributed to the increase in true contact area by creep of PTFE. No adhesion was measurable at long contact times with contaminated tungsten tips. Neon field ion micrographs taken after the contacts show many linear and branched arrays which appear to represent PTFE that remains adhered to the surface even at the high electric fields required for imaging. Author

N72-29598*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ADDITION-TYPE POLYIMIDES FROM SOLUTIONS OF MONOMERIC REACTANTS
Peter Delvigs, Tito T. Serafini, and George R. Lightsey Washington Aug. 1972 21 p refs
(NASA-TN-D-6877; E-6750) Avail: NTIS HC $3.00 CSCL 11D

The monomeric reactants approach was used to fabricate addition-type polyimide/graphite fiber composites with improved mechanical properties and thermal stability characteristics over those of composites derived from addition-type amide acid prepolymers. A screening study of 24 different monomer combinations was performed. The results of a more extensive investigation of a selected number of monomer combinations showed that the combination providing the best thermomechanical properties was 5-norbornene-2,3-dicarboxylic acid monomethyl ester/4,4'-methylenedianline/3,3'4,4'-benzophenone tetracarboxylic acid dimethyl ester at a molar ratio of 2/3.09/2.09. Author

N72-29599# National Aviation Facilities Experimental Center, Atlantic City, N.J.
EVALUATION OF POLYURETHANE SHROUD DESIGNED TO PREVENT TACAN WEATHER OUTAGES Final Report, Dec. 1970 - May 1971
George J. Hartranft Aug. 1972 40 p
(FAA Proj. 041-306-02X)
(FAA-NA-72-34; FAA-RD-72-78) Avail: NTIS HC $4.00

The evaluation determined the effectiveness of the shroud in preventing and removing snow and ice accumulations from the TACAN antenna. The data indicated that although the shroud did not completely eliminate weather outages; it was successful in preventing and removing snow and ice accumulations. Author

N72-29600# Sandia Labs., Livermore, Calif.
FILAMENT WOUND MATERIALS EVALUATION WITH ACOUSTIC EMISSION
D. K. Rathbun, A. G. Beattie, and L. A. Hiles Apr. 1971 26 p refs Presented at the 8th Symp. of Nondestructive Evaluation, San Antonio, 22 Apr. 1971
(Contract AT(29-1)-789)
(SCL-DC-70-260; Conf-710454-1) Avail: NTIS

Experiments are described which establish that (a) broken strands generate detectable acoustic emission in tensile specimens, (b) acoustic emission pulses originate from areas undergoing structural damage in spherical test shapes, and (c) the region which ultimately fails emits large quantities of acoustic waves prior to failure. It was not possible to establish a statistical relationship between acoustic emission events and broken or damaged strands; however, it is believed that such a relation may exist. Author

N72-29601# Pennsylvania State Univ., University Park. Dept. of Materials Science.
CERAMIC RESEARCH ON TRANSFORMATIONAL SUPERPLASTICITY AND THE ELECTRON MICROSCOPY OF FERROELECTRIC DOMAIN BOUNDARIES Research Progress Report, 1 Jun. 1971 - 31 May 1972
Richard C. Bradt and John H. Hoke 31 May 1972 18 p
(Contract AT(11-1)-3420)
(COO-3420-1) Avail: NTIS

The transmission electron microscopy of ferroelectric domains has yielded extensive information concerning the structure and interactions of domain boundaries in several single crystal and polycrystalline forms of barium titanate, and the characterization of domain processes at the phase transformations. Initial experimental difficulties of the superplasticity observations have been overcome, and both isothermal and transformational superplasticity have been observed and studied in bismuth oxide. Some characterization of the superplasticity has been completed, indicating some of the effects of stress, microstructure, and transformational heating rate. Author

N72-29602# Explosives Research and Development Establishment, Waltham Abbey (England).
GLASS FILLED THERMOPLASTICS: EFFECTS OF GLASS VARIABLES AND PROCESSING ON PROPERTIES
R. W. Richards and D. Sims Jan. 1972 41 p refs
(ERDE-TR-88; BR-29467) Avail: NTIS HC $4.25

The effect of glass variables, diameter, and size content, on the mechanical properties of glass filled materials was determined in polypropylene, polystyrene and nylon 6. The combined effects of silane coupling agents and injection molding machine conditions were also investigated with glass/polymer dry blends using the barrel of the molding machine as a mixer. The silanes giving optimum properties in polypropylene and nylon 6 were identified

and certain important machine conditions specified.
Author (ESRO)

N72-29603# Princeton Univ., N.J. Frick Chemical Lab.
A PHYSICAL CHARACTERIZATION OF THREE UNUSUAL POLYSTYRENES
Warren F. Knoff and Arthur V. Tobolsky Mar. 1972 28 p refs
(Contract N00014-67-A-0151-0011; NR Proj. 056-377)
(AD-740171; RLT-133) Avail: NTIS CSCL 11/9

Three specially blended polystyrene samples with rather unique molecular weight distributions have been mechanically characterized by stress relaxation and creep at several temperatures. Where possible master curves have been constructed and free volume parameters have been determined and discussed in light of the unusual molecular weight distributions. Author (GRA)

N72-29604# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
THERMAL REGENERATION OF THE TENSILE PROPERTIES OF HYDROLYTICALLY DEGRADED POLYIMIDE FILM
Richard Delasi Apr. 1972 26 p refs
(AD-740292; RM-538) Avail: NTIS CSCL 11/9

Heat treatment at temperatures of 224 to 310 C of hydrolytically degraded polyimide film has been shown to regenerate the ultimate tensile strength from 15.1 ksi to 24.3 ksi after 80 hours at 224 C and to 25.8 ksi after two hours at 310 C, whereas the elongation to failure is simultaneously increased from 4.8 to 29.0 percent at 224 C and to 38.4 percent at 310 C. The kinetics of this regeneration indicate that the reaction corresponds to the two-step recombination of the hydrolytically attacked amide linkages that were initially present in the as-received polyimide film. The regenerated polyimide exhibits a much improved hydrolytic stability over the untreated material and specimens heat treated directly without prior aqueous degradation. Author (GRA)

N72-29605# Pennsylvania State Univ., University Park. Materials Research Lab.
HIGH STRENGTH CERAMICS Final Report
H. A. McKinstry, H. E. Shull, and W. R. Buessem 30 Mar. 1972 96 p refs
(Contract N00014-67-A-0385-0004)
(AD-740215) Avail: NTIS CSCL 11/2

Contents: Stress concentration in elastically anisotropic bi-crystal tensile specimens; Stress distributions in Al2O3 bicrystal tensile specimens; A study of a two-dimensional finite element model of a ceramic body. GRA

N72-29606# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RATE OF VAPORIZATION AND EROSION OF SILICON CARBIDE BASED CERAMICS
R. I. Abraitis, I. S. Mayauskas, V. V. Yanulis, A. I. Rekov, and V. E. Serebrennikova 4 Jan. 1972 11 p Transl. into ENGLISH from the publ. "Materialy dlya Kanala MGD-Generatora' 1969 p 34-36
(AF Proj. 3145)
(AD-740195; FTD-MT-24-1149-71) Avail: NTIS CSCL 11/2

The authors study the rate of vaporization up to 2000 degrees K of ceramics based on silicon carbide and alloyed with refractory metals. Resistance of ceramics to erosion was also studied at 2000 degrees K. It was shown that intense vaporization of ceramics begins at 1950 degrees K in air and that such materials can function up to that temperature.
Author (GRA)

N72-29607# Naval Ordnance Lab., White Oak, Md.
PYROLYTIC DEGRADATION OF A PHENYLATED IMIDE QUINOXALINE COPOLYMER
Joseph M. Augl 3 Apr. 1972 31 p refs
(AD-741204; NOLTR-72-36) Avail: NTIS CSCL 11/9

Three batches of PPIQ, a polyphenylimide-quinoxaline copolymer, poly(2,2'-(N,N'-bis(1,4- phenylene) benzophenone 3,3',4,4'-tetracarboxylimide) 6,6'-bis(3-phenyl quinoxaline)), were prepared differing in molecular weights and ploymer chain endings. Their thermal degradation in vacuum and air was determined by isothermal weight loss measurements. As in the case of PPQ, poly(2,2:-(1,4-phenylene)-6,6:-bis(3-phenylquinoxaline)), the temperature coefficient of thermal degradation in air was independent of molecular weight. However, in contrast to PPQ, the temperature coefficient was also independent of the type of polymer end groups. Author (GRA)

N72-29608# Naval Research Lab., Washington, D.C.
THE WETTABILITY AND DETECTION OF FLOURESCENT BARRIER FILMS Interim Report
Vincent G. Fitzsimmons and Elaine G. Shafrin 31 Mar. 1972 19 p refs
(AD-741206; NRL-7391) Avail: NTIS CSCL 11/3

The storage and operational life of instrument ball bearings are greatly improved by barrier films, i.e., thin films of fluorinated organic polymers applied to the metal surface to prevent the spread or migration of lubricant liquid away from critical bearing areas. Because major operational and economic advantages are derived from the use of extremely thin films (0.1 to 1.0 micron), the optimum coatings are difficult to detect visually. Current difficulties in determining barrier-film location could be alleviated by incorporating a suitable fluorescent indicator in the dilute solutions used to prepare the barrier films. Air-dried and heat-dried coatings solvent-deposited from an experimental formulation containing such an indicator are shown to exhibit a useful level of fluorescence under UV radiation after solidification in situ. Wear and storage tests were conducted. Silicone oil-retention experiments and extensive contact angle measurements for a variety of organic liquids reveal no significant difference in wettability between the commercial and the experimental films. Author (GRA)

N72-29609# General Electric Co., Philadelphia, Pa. Missile and Space Div.
INVESTIGATION OF ELECTRONIC CERAMIC FIBERS FOR NONDESTRUCTIVE EVALUATION OF ADVANCED COMPOSITES Final Report, 16 Feb. 1971 - 15 Feb. 1972
Edward C. Henry 15 Feb. 1972 42 p refs
(Contract N00019-71-C-0247)
(AD-741236) Avail: NTIS CSCL 11/5

The objective was to investigate the feasibility of developing and using crystal-bearing filaments as sensors in the non-destructive evaluation of fiber-reinforced plastic structural materials. The fibers or filaments contain crystalline oxidic materials commonly referred to as electronic ceramics. Compositions investigated include several soft and hard magnetic ferrites and ferroelectric potassium sodium niobate and lithium niobate. Author (GRA)

N72-29610# Princeton Univ., N.J. Dept. of Chemical Engineering.
THERMOMECHANICAL BEHAVIOR OF POLY (CARBORANE-SILOXANE)S CONTAINING -CB5H5C- CAGES Technical Report, Sep. 1969 - Mar. 1972
John K. Gillham and Mark B. Roller Mar. 1972 35 p refs
(Contract N00014-67-A-0151-0024)
(AD-741257; TR-6) Avail: NTIS CSCL 11/9

The first thermomechanical spectra of two new carborane-siloxane polymers containing 5-boron carborane cages in the backbone are reported and discussed. The polymers are: the homopolymer, HO-(Si(CH3)2-CB5H5C-Si(CH3)2-O)(n)H and the random copolymer of the above with twenty mole percent of its 10-boron meta carborane analogue: -(Si(CH3)2-CB10H10C-Si (CH3)2-O)(n). The mechanical spectra (about 1 cps) were determined from -180 C to -625 C to -180 C via the semimicro thermomechanical technique of torsional braid analysis. The T(g):s indicate an unusually high degree of chain flexibility for a

polymer with such bulky groups in its backbone. Their thermal stability in both air and nitrogen were studied. Author (GRA)

N72-29611# Army Foreign Science and Technology Center, Charlottesville, Va.
INVESTIGATION TECHNIQUE OF MICROHARDNESS OF HIGH MELTING POINT ALLOYS IN A WIDE TEMPERATURE RANGE
V. N. Skuratovskii, Yu. G. Tkachenko, and V. A. Borisenko 27 Jan. 1972 13 p refs Transl. into ENGLISH from Probl. Prochnosti v Mashinostr. (USSR), no. 4, Oct. 1969 p 74-78
(AD-741048; FSTC-HT-23-681-71) Avail: NTIS CSCL 11/2

The study of high-melting compounds, such as carbides, borides and nitrides, by the microhardness method is still an acceptable means of observing their static hardness over a wide range. The purpose here is to consider certain methodological problems in the study of microhardness in these substances over a wide temperature range--the preparation of test samples, and the selection of load and of the time-parameters of loading. Author (GRA)

N72-29612# Prodesco, Inc., Perkasie, Pa.
PRODUCTION OF A SERIES OF HIGH TEMPERATURE RESISANT FABRICS TO REPLACE CURRENT SPECIFICATION NYLON AND COTTON FABRICS Final Report, Jun. 1970 - Dec. 1971
Robert Donnelly Wright-Patterson AFB, Ohio ASD Feb. 1972 78 p refs
(Contract F33657-70-C-1173; AF Proj. 412)
(AD-740600; ASD-TR-2) Avail: NTIS CSCL 11/5

A development program designed to replace flammable fabrics in aircraft is reported. Specification materials used by the Air Force, generally cotton, nylon or combinations of the two, were replaced by aromatic polyamide (Nomex) fabrics of equal or better properties for a given requirement. Seven different fabrics were developed, tested, and draft specifications suitable for future prototype procurement were written. Serviceability, costs, and large quantity production considerations were not within the scope. Primarily, staple fabrics were developed because of volume requirements. However, three filament items were developed, two narrow fabrics, and a new warp knit fabric which can serve as a basic fabric for applications requiring moderate stretch characteristics. Author (GRA)

N72-29613# Army Foreign Science and Technology Center, Charlottesville, Va.
INTRODUCTION TO THE MECHANICS OF REINFORCED POLYMERS
A. L. Rabinovich 22 Mar. 1972 679 p refs Transl. into ENGLISH of "Vvedeniye v Mekhaniku Armirovannykh Polimerov" Moscow, Nauka Press, 1970
(AD-742160; FSTC-HT-23-1068-72) Avail: NTIS CSCL 11/9

The study includes the deformation rules for hard polymers which are used as binders, the generation, for such polymers of a complete system of equations and development of methods for the solution of these equations, and the establishment of the areas of applicability of the existing methods related to the theory of resilience, pliability, and material deformation resistance, as applied to the binders. Also discussed is the purely mechanical study of joint deformation related to the reinforcing materials and to the polymers of the binder; the development of methods for the determination of characteristics related to the reinforced polymers on the basis of the properties of their components. Although the report presents some examples of the theory's application to the solution of some concrete problems, the main purpose is to lay the foundation for coupling equations suggested for the description of the mechanical behavior of the binders and reinforced plastic materials, and also to generate the system of equations describing the mechanics of the polymer medium. Author (GRA)

N72-29614# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METALLIC REINFORCING MATERIAL AND METAL FIBER COMPOSITE MATERIALS
A. Wende 9 Feb. 1972 14 p Transl. into ENGLISH from Plaste Kautschuk (Leipzig), v. 18, no. 1, 1971 p 3-6
(AF Proj. 3066)
(AD-742414; FTD-HC-23-1568-71) Avail: NTIS CSCL 11/9

The physical properties and uses of plastics reinforced with quartz fibers, steel wires, glass fibers, boron fibers, and boron tungsten fibers are discussed. GRA

N72-29615# Solar, San Diego, Calif.
TUNGSTEN REINFORCED OXIDATION RESISTANT COLUMBIUM ALLOYS Final Report, 1 Nov. 1970 - 1 Dec. 1971
Mark J. Klein, Brad R. Domes, and Arthur G. Metcalfe Feb. 1972 88 p refs
(Contract N00019-17-C-0158; N00019-71-C-0137)
(AD-740844; RDR-1693-4) Avail: NTIS CSCL 11/4

High-strength, oxidation-resistant composites are being developed for use in gas turbine engines at temperatures exceeding 2000 F. In previous work a model system composite consisting of a CB-40Ti-9Cr-4Al matrix and W-3Re filaments was developed and tested. During the present period, testing of the model system was continued to further characterize this material. In addition, the matrix composition was modified to improve composite ductility. The improved matrix selected for use in the composite is Cb-42Ti-4Cr-4Al-1V. The composite developed has good oxidation resistance but is intended to be used in the coated condition with the oxidation resistance serving as a fail-safe protection. Author (GRA)

N72-29616# Naval Ordnance Lab., White Oak, Md.
PYROLYTIC DEGRADATION OF POLYPHENYLQUINOXALINES
Joseph M. Augl 3 Apr. 1972 48 p refs
(AD-741203; NOLTR-72-21) Avail: NTIS CSCL 11/9

A series of poly(2,2'(N,N'-bis(1,4-phenylene) benzophenone 3,3',4,4'-tetracarboxylimide) 6,6'-bis(3-phenyl quinoxaline)) (PPQ polymers) differing in molecular weights and ploymer chain endings were prepared and their thermal degradation in air and vacuum was determined by isothermal weight loss measurements. It was found that the temperature coefficient (an apparent activation energy) of the thermal-oxidative degradation is dependent on the type of polymer chain endings, but not on molecular weight differences. Author (GRA)

N72-29617# Army Materials and Mechanics Research Center, Watertown, Mass.
CERAMIC EUTECTICS
Frederick Schmid and Dennis J. Viechnicki Mar. 1972 13 p Presented at the 73d Ann. Ceram. Soc. Meeting, Chicago, 27 Apr. 1971
(DA Proj. 1T0-62105-A-330)
(AD-741812; AMMRC-TR-72-8) Avail: NTIS CSCL 11/2

Metal oxide ingots with fine grain size can be fabricated by growth from the melt. An oriented lamellar-type microstructure free of cracks is developed in the Al_2O_3/ZrO_2 eutectic system by controlled solidification with the gradient furnace. The colonies inherent in ingots grown by a modified Bridgman technique have been eliminated and also a lamellar-type rather than a rod-type microstructure is produced in ingots grown with the gradient furnace. Cracking does not occur at the eutectic grain boundaries as it does for polycrystalline aggregates of Al_2O_3, $MgAl_2O_4$, or $Y_3Al_5O_{12}$ solidified from the melt. (Authors) GRA

N72-29618# Army Materials and Mechanics Research Center, Watertown, Mass.
OXIDATION BEHAVIOR OF A COMPLEX DISILICIDE COATING: Ta-10W ALLOY SYSTEM AT TEMPERATURES OF 1700 TO 2700 F

Milton Levy and Joseph J. Falco Dec. 1971 23 p refs
(DA Proj. 1T0-62105-A-328)
(AD-741805; AMMRC-TR-71-59) Avail: NTIS CSCL 11/3

The oxidation behavior of a complex disilicide coating - 90Ta-10W alloy system was studied using thermogravimetric, X-ray diffraction and electron microprobe analyses. The coating afforded the alloy substrate complete protection against static oxidation for at least 200 hours at temperatures between 1700 to 2700 F. The excellent oxidation resistance of the coating system is due to the formation of a protective layer which consists mainly of SiO2 with some Ti, V, and W in solution and a second dispersed phase of TiO2. While this protective layer is glassy at and above 2100 F, the reaction products become increasingly crystalline with decreasing temperature between 1700 and 2000 F. Authors (GRA)

N72-29619# Army Materials and Mechanics Research Center, Watertown, Mass.
PHYSICAL PROPERTIES OF RARE EARTH-COBALT MAGNET MATERIALS Technical Report, 1 Jul. - 31 Dec. 1971
David R. Chapman and Laurence D. Jennings, Jr. Feb. 1972 12 p
(ARPA Order 1914)
(AD-742206; AMMRC-TR-72-5) Avail: NTIS CSCL 20/3

The magnetization of a number of commercial SmCo5 magnets has been measured as a function of stress and temperature. These measurements are significant to present and proposed applications of the magnets and also to characterization and an understanding of the mechanisms involved. Application of a compressive stress of 10,000 psi, which is near the strength of the material, has a negligible effect at temperatures up to 215 C, at least. Heating the sample, on the other hand, induces not only the previously studied reversible and irreversible losses, but also time-dependent and permanent loss. The time-dependent losses indicate a range of relaxation times. The dependence of these relaxation times and of the permanent loss on external parameters and on sample history is complicated, and only preliminary characterization has been obtained to date, as illustrated by a number of examples. Author (GRA)

N72-29499 Stanford Research Inst., Menlo Park, Calif.
ON THE STRENGTH OF CERAMICS AS A FUNCTION OF MICROSTRUCTURE, GRINDING PARAMETERS, SURFACE FINISH, AND ENVIRONMENTAL CONDITIONS
Rudolf Sedlacek, F. A. Halden, and P. J. Jorgensen *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 89-97 refs (For availability see N72-29492 20-15)

N72-29506 Naval Research Lab., Washington, D.C. Chemistry Div.
THE EFFECT OF SPUTTERING ON SURFACE TOPOGRAPHY AND STRENGTH OF CERAMICS
R. W. Rice *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 171-187 refs (For availability see N72-29492 20-15)

N72-29515 Naval Research Lab., Washington, D.C.
THE STRENGTH OF GAS POLISHED SAPPHIRE AND RUTILE
R. W. Rice, P. F. Becher, and W. A. Schmidt *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 267-269 refs (For availability see N72-29492 20-15)

N72-29516 Bell Telephone Labs., Inc., Allentown, Pa.
ANALYSIS AND CHARACTERIZATION OF CERAMIC SURFACES FOR ELECTRONIC APPLICATIONS
R. C. Sundahl and L. Berrin *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 271-291 refs (For availability see N72-29492 20-15)

N72-29517 Accumet Engineering Corp., Hudson, Mass.
SURFACE CHARACTERISTICS OF CERAMIC SUBSTRATES FOR HYBRID AND MICROWAVE ELECTRONIC CIRCUITS
Jackson K. Emery *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 293-300 refs (For availability see N72-29492 20-15)

N72-29518 Bell Telephone Labs., Inc., Allentown, Pa.
CERAMIC SURFACE TEXTURE BY REFLECTIVE REPLICA TECHNIQUE
Wing C. Lo *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 301-308 (For availability see N72-29492 20-15)

N72-29519 Pennsylvania State Univ., University Park.
QUANTITATIVE SURFACE FINISH CHARACTERIZATION BY CESEMI
E. W. White, H. A. McKinstry, and A. Diness (Office of Naval Res., Arlington, Va.) *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 309-316 refs (For availability see N72-29492 20-15)
(Contract N00014-67-A-0385)

N72-29520 Honeywell, Inc., Hopkins, Minn.
AN ASSESSMENT OF SURFACE AND SUBSURFACE DAMAGE INTRODUCED IN CERAMICS BY SEMIFINISH GRINDING OPERATIONS
B. G. Koepke *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 317-332 refs Sponsored by Navy (For availability see N72-29492 20-15)

N72-29522 Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
ACOUSTIC EMISSION MONITORING OF SURFACE-DAMAGED CERAMIC MATERIALS
L. R. Bunnell, J. C. Crowe, and P. E. Hart *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 341-342 refs (For availability see N72-29492 20-15)

N72-29523 Honeywell, Inc., Hopkins, Minn.
EFFECTS OF SURFACE FINISHING ON MECHANICAL AND OTHER PHYSICAL PROPERTIES OF CERAMICS
Robert J. Stokes *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 343-352 refs (For availability see N72-29492 20-15)

N72-29524 Ceramic Finishing Co., State College, Pa.
STRENGTH EFFECTS RESULTING FROM SIMPLE SURFACE TREATMENTS
H. P. Kirchner, R. M. Gruver, and R. E. Walker *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 353-363 Sponsored by Navy (For availability see N72-29492 20-15)

N72-29525 Naval Research Lab., Washington, D.C.
THE EFFECT OF GRINDING DIRECTION ON THE STRENGTH OF CERAMICS
R. W. Rice *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 365-376 refs (For availability see N72-29492 20-15)

N72-29526 Southern Research Inst., Birmingham, Ala.
THE INFLUENCES OF MATERIAL REMOVAL ON THE STRENGTH AND SURFACE OF AN ALUMINA
H. S. Starrett *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 377-387 refs (For availability see N72-29492 20-15)

N72-29527 Stanford Research Inst., Menlo Park, Calif.
THE EFFECT OF GRINDING VARIABLES ON THE STRENGTH AND SURFACE FINISH OF ALUMINA
Rudolf Sedlacek, F. A. Halden, and P. J. Jorgensen *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 391-398 refs (For availability see N72-29492 20-15)
(Contracts NOw-66-0383-d; N00019-67-C-0494)

N72-29528 Bell Telephs Labs., Inc., Allentown, Pa.
EDGE EFFECT ON THE MODULUS OF RUPTURE OF CERAMIC SUBSTRATES
Wing C. Lo *In* NBS The Sci. of Ceramic Machining and Surface Finishing May 1972 p 399-400 (For availability see N72-29492 20-15)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers.

N72-29620*# Brown Univ., Providence, R.I.
OSCILLATIONS IN NEUTRAL FUNCTIONAL DIFFERENTIAL EQUATIONS
Jack K. Hale 15 Jun. 1972 14 p refs
(Grants NGL-40-002-015; AF-AFOSR-2078-71; DA-ARO(D)-31-124-71-G12S2)
(NASA-CR-127803) Avail: NTIS HC $3.00 CSCL 12A

Fredholm alternative for the existence of periodic solutions of a nonhomogeneous linear neutral functional differential equation was announced. Boundary value problems were used to solve the theorems. Author

N72-29621*# Techtran Corp., Glen Burnie, Md.
THEOREM OF OPTIMAL DIVISION OF POINT OF VARIABLE MASS
J. M. Moskalenko Washington NASA Aug. 1972 9 p refs Transl. into ENGLISH of "Teorema ob Optimalnom Delenii Tochki Peremen. Massy" Rept. Pr-85 Acad. Sci. USSR, Moscow, 1971 11 p
(Contract NASw-2037)
(NASA-TT-F-14343; PR-85) Avail: NTIS HC $3.00 CSCL 12A

The point of variable mass for which the rate of mass loss may acquire various values, including 0, is examined. A theorem that establishes the external law of division of a point in motion is derived by considering the mass characteristics, gravitational forces, trajectorial data, aerodynamic effect of the atmosphere and altitude characteristic of the reactive force. The conditions of division of a point with consideration of optimal accelerations are illustrated by linear and power laws of change of mass. It is shown that the presently known recommendations on the division of a point of variable mass are special cases of the derived theorem. Author

N72-29622*# Techtran Corp., Glen Burnie, Md.
INTERFERING PARAMETERS IN A SCHEME OF LINEAR REGRESSION
V. L. Mazo Washington NASA Aug. 1972 22 p refs Transl. into ENGLISH of "Meshayushchiye Parametry v Skheme Lineynoy Regressii" Rept. Pr-89 Acad. Sci. USSR, Moscow, 1972 27 p
(Contract NASw-2037)
(NASA-TT-F-14378; PR-89) Avail: NTIS HC $3.25 CSCL 12A

A standard scheme of linear regression and scheme of linear regression with interfering parameters are investigated. The main objectives of the schemes are described, and the use of the method of least squares is illustrated. The geometric interpretation of estimates of the least squares and unbiased estimates is formulated. The coincidence of the set of estimates of least squares and set of unbiased estimates is proved. Theorems of optimal estimates in the unbiased class are proved. Author

N72-29623*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
COMPUTATION OF HANSEN COEFFICIENTS
J. R. Cherniack 27 Jul. 1972 30 p refs
(Grant NGR-09-015-002)
(NASA-CR-127383; SAO-Special-Rept-346) Avail: NTIS HC $3.50 CSCL 12A

Some procedures are presented for computer development of Hansen coefficients. The method of Von Zeipel and Andoyer was found to be most efficient. A table extends the method from 7th to 12th order. Author

N72-29624# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
SIMULATION STUDIES OF STOCHASTIC AUTOMATA MODELS. PART 1: REINFORCEMENT SCHEMES
R. Viswanathan and Kumpati S. Narendra Dec. 1971 87 p refs
(Grant NSF GK-20580)
(CT-45-Pt-1) Avail: NTIS HC $6.50

The results are presented of extensive computer simulations carried out to investigate the relative convergence properties of various automata schemes. Linear, nonlinear and hybrid schemes for the automata are treated separately. In each case the automata schemes are compared on the basis of: (1) speed of convergence, (2) degree of expediency, and (3) variance associated with the convergence process. Author

N72-29625# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
NONMATCHING IN MODEL REFERENCE ADAPTIVE SYSTEMS: SOME PROBLEMS AND RESULTS
Gerd Lueders and Kumpati S. Narendra May 1972 15 p
(CT-49) Avail: NTIS HC $3.00

The problem of nonmatching in model reference adaptive control and identification has been considered in order to provide an analysis and design procedure for a class of real systems when exact matching between model and plant is not possible. It has been shown that the same controller which has been used when perfect matching is possible can also be used in a nonmatching situation if a matrix P can be found which satisfies certain conditions depending on the range of the expected variations of the plant matrix. If such a matrix P is used to implement the adaptive controller, then the output error between the model and the plant will be bounded for any variations of the plant matrix over the range of values considered. Author

N72-29626# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
COMPETITIVE AND COOPERATIVE GAMES OF VARIABLE-STRUCTURE STOCHASTIC AUTOMATA
R. Viswanathan and Kumpati S. Narendra Nov. 1971 57 p refs
(CT-44) Avail: NTIS HC $5.00

The investigation of automata in game situations provides a possible means of modeling group behavior. The relative learning capabilities of two given automata may be exhibited by letting them play competitive (zero sum) games against each other. The performance of a given group of automata, all aiming toward a common goal, may be understood by observing their behavior in cooperative games. A properly organized cooperative group of automata can be effectively applied to learning system problems with multimodal performance criteria. Author

N72-29627# RAND Corp., Santa Monica, Calif.
RELATIONS CONNECTING THE DIRAC, HAMILTON-JACOBI, AND GAUGE EQUATIONS
B. W. Augenstein May 1972 8 p refs

(P-4808) Avail: NTIS HC $3.00

It is shown that classes of exact solutions of the Dirac equation can be constructed out of combinations of gauge functions and action functions. Standard 4-vector notation is used, with a pseudo-Euclidean metric. Author

N72-29628# National Physical Lab., Teddington (England). Div. of Numerical Analysis and Computing.

SOLUTION OF MIXED BOUNDARY VALUE PROBLEMS IN FINITE DOMAINS BY FOURIER'S METHOD

D. H. Ferriss Apr. 1972 53 p refs

(NPL-NAC-16) Avail: NTIS HC $4.75

A combined analytical and numerical technique based on Fourier's method is applied to three representative boundary value problem arising in various branches of physics and applied mathematics. Two of these problems contain boundary conditions of a mixed kind on one boundary which in one case results in a singularity in the solution whilst the third is a two dimensional eigenvalue problem in an L-shaped region. In all cases different methods of solution are compared, and the relative merits and limitations of these techniques are discussed. Author (ESRO)

N72-29629# National Physical Lab., Teddington (England). Div. of Numerical Analysis and Computing.

THE IMPLEMENTATION OF TWO REVISED QUASI-NEWTON ALGORITHMS FOR UNCONSTRAINED OPTIMIZATION

P. E. Gill, W. Murray, and R. A. Pitfield Apr. 1972 135 p refs

(NPL-NAC-11) Avail: NTIS HC $8.75

Two revised algorithms are given for unconstrained optimization using quasi-Newton-Raphson methods. The method is based on recurring factorization of an approximation to the Hessian matrix. Knowledge of that factorization allows greater flexibility when choosing the direction of search while mimimizing the adverse effects of rounding errors. The control of rounding error is important when analytical derivatives are not available. A modification of the algorithm to accept finite difference approximation to the derivatives is given. The ALGOL programs for function minimization with and without derivatives are given. The derivative and nonderivative procedures were used to solve several test problems. ESRO

N72-29630# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.

ADAPTIVE RANDOM SEARCH

J. Kregting and R. C. White, Jr. Oct. 1971 24 p refs

(TH-71-E-24) Avail: NTIS HC $3.25

Two theoretical random search methods, optimum directional random search (ODRS), and optimum half-space random search (OHSRS), were analyzed in an attempt to evaluate the improvement in performance resulting from the inclusion of directional information in a random search algorithm for multivariable function minimization. Although the improvement is significant in comparison with a similar method without directional information, the number of function evaluations required by ODRS and OHSRS to minimize Q(x) = summation from i = 1 to n of (x sub i) squared remains a linear function of n. Practical algorithms, with and without adaptation of step size and search direction are tested for several functions. For each algorithm the number of function evaluations required for minimization increases linearly with the number of variables. Theoretical and numerical results indicate that directional adaptation improves performance significantly. ESRO

N72-29631# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

OPTIMAL STOCHASTIC LINEAR SYSTEMS WITH EXPONENTIAL PERFORMANCE CRITERIA AND THEIR RELATION TO DETERMINISTIC DIFFERENTIAL GAMES Interim Technical Report

D. H. Jacobson Apr. 1972 35 p refs

(Contract N00014-67-A-0298; NR Proj. 372-012)

(AD-740377; TR-631) Avail: NTIS CSCL 12/1

In the report two stochastic optimal control problems are solved whose performance criteria are the expected values of exponential functions of quadratic forms. The optimal controller is linear in both cases but depends upon the covariance matrix of the additive process noise so that the Certainty Equivalence Principle does not hold. The controllers are shown to be equivalent to those obtained by solving a cooperative and a noncooperative quadratic (differential) game, and this leads to some interesting interpretations and observations. Some stability properties of the asymptotic controllers are discussed.

Author (GRA)

N72-29632# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

THE IDENTIFICATION OF LINEAR STOCHASTIC SYSTEMS M.S. Thesis

Adolph Harris Mar. 1972 109 p refs

(AD-741437; GSA/MA/72-5) Avail: NTIS CSCL 12/1

The report considers the problem of the identification of linear stochastic systems. A current state-of-the-art assessment of the general field of system identification is given, and criteria for the classification and selection of identification methods are presented and discussed. Several of the more popular identification methods from the literature are investigated and summarized. A bibliography containing 185 references, keyed by identification methods and other relevant headings, is included. Using the state variable formulation for a discrete linear stochastic system, a detailed exposition of a few of the on-line identification methods currently appearing in the literature is presented.

Author (GRA)

N72-29633# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.

CONTROL THEORY FOR LARGE SCALE AND UNCERTAIN SYSTEMS APPLICABLE TO AEROSPACE SYSTEMS Final Report, 1 Feb. 1971 - 31 Jan. 1972

Michael Athans and Sanjoy K. Mitter Mar. 1972 43 p refs

(Grant AF-AFOSR-1941-70; AF Proj. 9769)

(AD-740869; ESL-FR-474; AFOSR-72-0947TR) Avail: NTIS CSCL 12/1

The report describes the research carried out by members of the Decision and Control Sciences Group at the Electronic Systems Laboratory, M.I.T. Research was carried out on the following main topics: Control and Decision Making under Uncertainty; Studies in Large-Scale Systems; Control of Distributed Parameter Systems; Control of Hereditary Differential Systems; and Air Traffic Control. Technical details of the research may be found in the reports and papers cited in the references. Author (GRA)

N72-29634# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Applied Mathematics Research Lab.

ON SOME NONCENTRAL DISTRIBUTIONS IN MULTIVARIATE ANALYSIS Final Report

P. R. Krishnaiah and A. K. Chattopadhay Feb. 1972 23 p refs

(AF Proj. 7071)

(AD-742264; ARL-72-0029) Avail: NTIS CSCL 12/1

In the paper, the authors derived expressions for the marginal distributions of any few consecutive ordered roots, moments of the elementary symmetric functions of the ordered roots and the Laplace transformations of the traces of a class of random matrices in the noncentral cases. This class of random matrices includes the MANOVA, Canonical Correlation, and Wishart matrices. The expressions obtained here are in terms of the linear combinations of the products of double integrals. These double integrals can be evaluated without difficulty for the cases of the random matrices that occur commonly in multivariate statistical analysis. Author (GRA)

N72-29635# California Univ., Los Angeles. School of Engineering and Applied Science.

PRACTICAL CONTROL THEORY FOR DISTRIBUTED

SYSTEMS
P. K. C. Wing 10 May 1972 9 p refs Presented at the 5th World Congr. of the Intern. Federation of Autom. Control., Paris, Jun. 1972
(Grant AF-AFOSR-1547-68; AF Proj. 9769)
(AD-742313; AFOSR-72-1157TR) Avail: NTIS CSCL 12/1

The basic difficulties in the synthesis of physically implementable controllers for distributed systems are discussed. A few possible directions for developing a practical control theory for distributed systems which takes these difficulties into consideration are presented. Some of the ideas are illustrated by simple examples. Author (GRA)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N72-29636*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND VELOCITY PROFILES MEASURED BY THE SMOKE-TRAIL METHOD AT WALLOPS ISLAND, VIRGINIA, 1965 - 1969
Richard H. Rhyne, James C. Manning, and Robert M. Henry Washington Aug. 1972 96 p refs
(NASA-TN-D-6861; L-8336) Avail: NTIS HC $3.00 CSCL 04B

Thirty-nine detailed wind profiles measured by the smoke-trail method at the Wallops Island Test Range during the years 1965 through 1969 are presented as west-to-east and south-to-north velocity components at height intervals of 25 meters. The overall altitude range of the wind profile data varies from about 1 to 23 km. The wind measurements, which were made under a variety of conditions, include velocities in excess of the annual 99-percent highest wind value (the wind value which will not be exceeded 99 percent of the time) for the Wallops Island Test Range. The report also includes a listing of the wind soundings and their maximum velocities and direction of the maximum velocities measured at Wallops Island from 1959 through 1969. Results of smoke-trail enhancement experiments are also indicated. Author

N72-29637# National Environmental Satellite Service, Washington, D.C.
OPERATIONAL PROCEDURES FOR ESTIMATING WIND VECTORS FROM GEOSTATIONARY SATELLITE DATA
Michael T. Young, Russell C. Doolittle, and Lee M. Mace Jul. 1972 26 p refs
(NOAA-TM-NESS-39) Avail: NTIS HC $3.50

The derivation of estimated wind speed and direction vectors from cloud motions observed by Applications Technology Satellites (ATS 1 and ATS 3) is discussed. Techniques used in converting digital satellite data into time-lapse film loops are described and illustrated. The analysis of cloud motion fields in the film loops and the preparation of these data as input for machine analysis into high and low level wind vectors are described. Software procedures for computer rectification of errors arising from angular distortions in the viewed cloud field are presented. Author

N72-29638# National Oceanic and Atmospheric Administration, Rockville, Md.
MISSISSIPPI DELTA TORNADOES OF 21 FEBRUARY 1971
Jul. 1971 63 p refs
(NOAA-NDSR-71-2) Avail: NTIS HC $5.25

The findings and recommendations of a survey team evaluating the effectiveness of tornado warning devices are presented. This evaluation occurred after the tornadoes on 21 Feb. 1971 in the Mississippi Delta and other parts of Louisiana, Mississippi, and Tennessee. Author

N72-29639# National Oceanic and Atmospheric Administration, Washington, D.C.
NATIONAL EAST COAST WINTER STORMS OPERATIONS PLAN
Nov. 1971 108 p
(FCM-71-8) Avail: NTIS HC $7.50

The operations plan designed to furnish weather observations for use in predicting and providing adequate and timely warnings of severe and crippling winter storms along the east coast of the U.S. is presented. The responsibilities are given for the following cooperating agencies: NOAA, DOD, FAA, U.S. Coast Guard, National Weather Service, U.S. Air Force, and the U.S. Navy. The requirements for aircraft reconnaissance flights are detailed, and charts are included showing the reconnaissance tracks for storm areas. Communication procedures, and networks are also included. F.O.S.

N72-29640# National Oceanic and Atmospheric Administration, Silver Spring, Md. Weather Analysis and Prediction Div.
LONG TERM VERIFICATION TRENDS OF FORECASTS BY THE NATIONAL WEATHER SERVICE
Duane S. Cooley and Robert G. Derouin May 1972 14 p refs
(NOAA-TM-NWS-FCST-18) Avail: NTIS HC $3.00

Averages of daily forecast verification records of the National Weather Service (NWS) (previously the United States Weather Bureau) over a period of many years are summarized and illustrated. Results of studying precipitation, temperature, wind, and pressure predictions made during the past two or three decades show that progress, though sometimes slow, is definitely being made in improving weather forecasts. Author

N72-29641# Environmental Protection Agency, Research Triangle Park, N.C.
AIR POLLUTION ASPECTS OF EMISSION SOURCES: BOILERS: A BIBLIOGRAPHY WITH ABSTRACTS
May 1972 129 p refs
(AP-105) Avail: NTIS HC $8.50

Boilers contribute significantly to the overall air pollution level in the United States. To aid efforts to improve air quality, the Air Pollution Technical Information Center (APTIC) of the Office of Air Programs has compiled this bibliography relevant to the problem and its solution. Approximately 490 abstracts were selectively screened from the contents of APTIC's information storage and retrieval system to cover 14 categories. Subject and author indexes refer to the abstracts by category letter and APTIC accession number. Generally, higher accession numbers, representing the latest acquisitions, cover the most recent material. Author

N72-29642# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Programs.
AIR POLLUTION ASPECTS OF EMISSION SOURCES: IRON AND STEEL MILLS - A BIBLIOGRAPHY WITH ABSTRACTS
May 1972 88 p refs
(AP-107) Avail: SOD $1.00

An annotated bibliography relevant to the air pollution problem by iron and steel mills is presented. Abstracts concerning emission sources, control methods, measurement methods, ecological and economic effects are reported. Approximately 302 abstracts are included. F.O.S.

N72-29643*# Lockheed-California Co., Burbank. Environmental Sciences Lab.
JIMSPHERE WIND AND TURBULENCE EXCEEDANCE STATISTIC Technical Report, 24 Nov. 1970 - 23 Nov. 1971
S. I. Adelfang and A. Court Washington NASA Aug. 1972 54 p refs
(Contract NAS8-26661)
(NASA-CR-2118; LR-24843) Avail: NTIS HC $3.00 CSCL 04B

Exceedance statistics of winds and gusts observed over Cape Kennedy with Jimsphere balloon sensors are described. Gust profiles containing positive and negative departures, from smoothed profiles, in the wavelength ranges 100-2500, 100-1900, 100-860, and 100-460 meters were computed from 1578 profiles with four 41 weight digital high pass filters. Extreme values of the square root of gust speed are normally distributed. Monthly and annual exceedance probability distributions of normalized rms gust speeds in three altitude bands (2-7, 6-11, and 9-14 km) are log-normal. The rms gust speeds are largest in the 100-2500 wavelength band between 9 and 14 km in late winter and early spring. A study of monthly and annual exceedance probabilities and the number of occurrences per kilometer of level crossings with positive slope indicates significant variability with season, altitude, and filter configuration. A decile sampling scheme is tested and an optimum approach is suggested for drawing a relatively small random sample that represents the characteristic extreme wind speeds and shears of a large parent population of Jimsphere wind profiles. Author

N72-29644*# Scientific Translation Service, Santa Barbara, Calif.
INFLUENCE OF TYPE OF SOIL ON NOCTURNAL TEMPERATURE VARIATIONS IN THE GROUND LEVEL LAYER OF AIR
K.-H. Grasnick Washington NASA Aug. 1972 18 p refs Transl. into ENGLISH from Z. Meteorol. (Berlin), v. 15, no. 1-6, Jan.-Jun. 1961 p 27-36
(Contract NASw-2035)
(NASA-TT-F-14508) Avail: NTIS HC $3.00 CSCL 04B

In an earlier paper nomograms have been established which permit the determination of the nocturnal temperature variation from evening measured data. These nomograms apply to one type of soil only. From a statistical investigation of the Linderberg lapse rate soundings by means of a mechanical lift a mean lapse rate was obtained. The inclusion of this constant lapse rate into the equation system permits the introduction of the type of soil as a new variable. Numerical evaluation reveals a useful knowledge of the qualitative effect of the several types of soil upon the near-ground temperature field. It is shown that the influence of the type of soil decreases at different levels above ground with increasing turbulent mixing and, for example, even vanishes at 76 m, while the influence of nocturnal terrestrial radiation becomes more important. Author

N72-29645# Brookhaven National Lab., Upton, N.Y.
SAMPLING PARTICULATES WITH ROTATING ARM IMPACTION SAMPLERS
Gilbert S. Raynor [1972] 27 p refs Presented at 1st Workshop Conf. on Ecological Systems Approaches to Aerobiol., Manhattan, Kans., 6 Jan. 1972
(BNL-16531; Conf-720113-1) Avail: NTIS

Rotating cylindrical impactors are discussed as the preferred method for sampling large particles from the atmosphere. The methods for using rotating impactor samplers are described, and their use for sampling pollens, large spores and other airborne particles above 6 to 10 microns is recommended. F.O.S.

N72-29646# Institut Royal Meteorologique de Belgique, Brussels.
ATMOSPHERIC POLLUTION, SMOKE, AND SULFUR DIOXIDE Monthly Bulletin Aug. 1971 [POLLUTION ATMOSPHERIQUE, FUMEE ET ANHYDRIDE SULFUREUX BULLETIN MENSUEL, AOUT 1971]
Aug. 1971 28 p In FRENCH and DUTCH Prepared jointly with Inst. d'Hyg. et d'Epidemiol.
Avail: NTIS HC $3.50

Data obtained at Belgian weather stations are tabulated. The air pollution apparatus is briefly described. ESRO

N72-29647# Institut Royal Meteorologique de Belgique, Brussels.
CLIMATOLOGICAL OBSERVATIONS Monthly Bulletin, May 1972 [OBSERVATIONS CLIMATOLOGIQUES, BULLETIN MENSUEL, MAI 1972]
R. Sneyers May 1972 17 p In FRENCH and DUTCH
Avail: NTIS HC $3.00

Meteorological parameters observed at various Belgian weather stations during May 1972 are given. ESRO

N72-29648# Stanford Research Inst., Menlo Park, Calif.
OBJECTIVE METHODS FOR REGISTERING LANDMARKS AND DETERMINING CLOUD MOTIONS FROM SATELLITE DATA
R. M. Endlick, D. J. Hall, D. E. Wolf, and A. E. Brain Oct. 1971 48 p refs
(Contract N62306-71-C-0068; SRI Proj. 1005)
(AD-740326; FAMOS-TR-8-71) Avail: NTIS CSCL 04/2

Methods are described for matching landmarks in cloud photographs made by ATS satellites so that sequences of such photographs can be precisely registered. Cloud motions may then be derived by comparing positioned data on successive pictures. Accurate registration is needed because the satellites cannot be placed in ideal synchronous orbits with perfect attitude stability. Thus, the satellite subpoint and attitude angles vary with time. For the ATS-III satellite the perturbations are small enough to allow corrections to be made. The methods given in this report are objective and are performed by the computer, using digital brightness data. In a general way they simulate human (visual) techniques for performing the same sort of manipulations. Corrections needed to register one picture to another are determined from the data transmitted by the satellite and recorded by a ground station and do not depend on knowledge of the spacecraft's behavior. Author (GRA)

N72-29649# Oklahoma Univ. Research Inst., Norman. Dept. of Meteorology.
THE RELATIONSHIP BETWEEN HORIZONTAL MOISTURE CONVERGENCE AND SEVERE STORM OCCURRENCES
William R. Newman Jan. 1972 59 p refs
(Grant NOAA-N22-47-72(G))
(AD-740392; OURI-1828-72-2) Avail: NTIS CSCL 04/2

An objective analysis of the wind and mixing ratio using three-hourly surface observations was used to obtain patterns of horizontal moisture convergence over the eastern two-thirds of the United States. Sixty-three segments of time periods during April and May 1970, were examined. All cases chosen had severe weather occurring during some portion of the entire period. A comparison was made between the fields of horizontal moisture convergence and reported severe weather occurrences. It was found that severe weather tends to develop at or closely after the time of strongest moisture convergence. Results of a quantitative study indicate that it may be beneficial to calculate horizontal moisture convergence on an hourly basis for use as a severe weather predictor. Author (GRA)

N72-29650# Oklahoma Univ. Research Inst., Norman. Atmospheric Research Lab.
A COMPARISON OF OBJECTIVE CONVECTIVE ACTIVITY INDICES
Darell R. Whitehead Nov. 1971 69 p refs
(Grant NOAA-N22-47-72(G))
(AD-740388; OURI-1828-71-1) Avail: NTIS CSCL 04/2

Three objective indices of convective activity are compared in an application to two case studies. The three indices are: the United States Air Force Global Weather Central SWEAT Index, the Lifted Index, and a quantity representing the vertical transport of moisture from the planetary boundary layer (qw). A variational analysis technique is applied to standard rawinsonde wind data to obtain boundary layer grid fields of kinematic parameters while a simple objective analysis is applied to obtain boundary layer grid fields for thermodynamic air properties. In this study, the boundary layer is represented by four levels from the surface to 3000 feet above terrain elevation in 1000-foot increments. It is shown that there are only minor differences in the areal resolution of potential thunderstorm threat areas depicted by the SWEAT Index and the Lifted Index.
Author (GRA)

N72-29651# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
HONEST JOHN 03703, MISSILE NO. 338, ROUND NO. 617 RGL, 14 MARCH 1972 Meteorological Data Report
Mar. 1972 21 p
(DA Proj. 1T6-65702-D-127)
(AD-740154; DR-699) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 03703 Honest John, Missile Number 338, Round Number 617 RGL, are presented in tabular form. Author (GRA)

N72-29652# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
LANCE 11602, MISSILE NO. 2142, ROUND NO. 147 SST, 18 FEBRUARY 1972 Meteorological Data Report
Feb. 1972 71 p
(DA Proj. 1T6-65702-D-127)
(AD-740153; DR-693) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 11602 Lance, Missile Number 2142, Round Number 147 SST, are presented in tabular form. Author (GRA)

N72-29653# Carleton Controls Corp., East Aurora, N.Y.
BAROMETRIC CHANGE INDICATOR Final Report
John C. Goodell, Richard D. Cummins, and Gerhard A. Reile 30 Dec. 1971 15 p ref
(Contract N00014-70-C-0367)
(AD-740130) Avail: NTIS CSCL 04/2

The paper provides a schematic presentation of a method of obtaining a recorded record of periodic readings of a Bar-O-Rater. The record may be obtained remote from the actual location of the basic instrument. Author (GRA)

N72-29654# Aerometric Research, Inc., Goleta, Calif.
LARGE SCALE EFFECTS OF CLOUD SEEDING, 1970 - 1971: SEASON AND FOUR YEAR SUMMARY Final Report
Keith J. Brown and Robert D. Elliott Oct. 1971 166 p refs
(Contract DI-14-06-D-6841)
(AD-740128; ARI-71-1) Avail: NTIS CSCL 04/2

The report is based on four years of data on the large scale effects of cloud seeding. The study was conducted in the area surrounding a randomized seeding project in Santa Barbara County, California sponsored by the Naval Weapons Center, China Lake, California. Seeding was accomplished from a point source using pyrotechnic seeding devices. The seeding and observation unit was a convective band. Substantial statistical zvidence is presented showing that precipitation has been significantly increased over a large area 70 to 125 miles from the seeding source. Evidence is also provided showing that the seeding effect is highly temperature dependent and that the time duration of bands is significantly increased as a result of seeding. Also shown is the interaction between convective bands, the possible effects of seeding on surface pressure and the diurnal effect of seeding. Author (GRA)

N72-29655# Naval Postgraduate School, Monterey, Calif.
PHASE SPEED ERRORS WITH SECOND AND FOURTH ORDER SPACE DIFFERENCES WITH STAGGERED AND UNSTAGGERED GRIDS
Roger T. Williams 21 Mar. 1972 24 p refs
(EPRF Proj. 55319; FNWC Proj. 55308)
(AD-741223; NPS-51Wu72031A) Avail: NTIS CSCL 04/2

The linearized barotropic primitive equations are used to investigate the phase speed errors which arise from space truncation. Phase speed errors are compared for second and fourth order approximations to the space derivatives. These errors are also investigated on two staggered grids.
Author (GRA)

N72-29656# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
CLIMATOLOGY AS A FUNCTION OF MAP TYPE Environmental Research Papers
Iver A. Lund 6 Mar. 1972 22 p refs
(AF Proj. 8624)
(AD-740855; AFCRL-72-0173; AFCRL-ERP-391) Avail: NTIS CSCL 04/2

Four sets of eight objectively produced map types were generated for use in estimating the probability of four six-hourly precipitation categories observed at Travis AFB, California. Daily precipitation probability forecasts were prepared for 585 winter days using ten different procedures. All four sets of map types yield six-hour precipitation forecasts that are better than unconditional climatology, but none of them yield as much information as climatology conditioned on past six-hourly precipitation. Climatology conditioned on both past precipitation and map type is the best. Author (GRA)

N72-29657# Miami Univ., Fla. Meteorological Labs.
SATELLITE AND RADAR ANALYSIS OF MESOSCALE WEATHER SYSTEMS IN THE TROPICS Semiannual Report, 1 Jun. - 31 Dec. 1971
Harold P. Gerrish Fort Monmouth, N. J. ECOM Mar. 1972 44 p refs
(Contract DAAB07-71-C-0277)
(AD-741392; UM-RSMAS-72034; ECOM-0277-22; SAR-22) Avail: NTIS CSCL 04/2

Gridded Miami WSR-57 radar PPI data during the summer of 1968 are used to study the coverages and frequencies of radar echoes typically associated with five convective regimes in South Florida. Three sets of maps are presented showing the average coverage considering all of the data, the average coverage per echo incident, and the frequency distribution of grid squares containing echoes at 0800, 1200, 1600 and 2000 EST. The maps are discussed with respect to convective echo activity, and with regard to preferred regions for the occurrence of anomalous propagation (A.P.). Various local effects are noted and one outstanding hot spot of convection is observed in the Lostman's River area along the southwest coast of Florida. These series of maps provide a basis for determining the degree of convection on a real-time basis. By definition, the degree of convection is related to specific daily rainfall data. Author (GRA)

N72-29658# Arctic Inst. of North America, Washington, D.C.
THE EFFECTS OF WATER BODIES ON AIR TEMPERATURE AND HUMIDITY DURING THE PERIOD PRECEDING THEIR FREEZING OR OPENING
B. P. Konovodov Jan. 1972 65 p refs Transl. into ENGLISH from Tr. Tsentr. Inst. Prognozov (USSR), v. 58 p 63-100
(Contract DACW35-68-C-0069)
(AD-741056; CRREL-TL305) Avail: NTIS CSCL 04/2

The characteristics of the effect of a body of water on the temperature and humidity of the air over it obtained in the report may be used for the calculation and forecasting of these factors over bodies of water during investigations and calculations of heat exchange, evaporation, water temperature, etc.
Author (GRA)

N72-29659# Panametrics, Inc., Waltham, Mass.
A ROCKET BORNE AIR DENSITY SYSTEM FOR THE 100-200 km REGION: DESIGN, CALIBRATION AND FLIGHT Final Report, 18 Mar. 1970 - 30 Nov. 1971
Bach Sellers, Frederick A. Hanser, and Jean L. Hunerwadel Feb. 1972 82 p refs
(Contract F19628-70-C-0241; AF Proj. 8605)
(AD-742360; AFCRL-72-0117) Avail: NTIS CSCL 04/2

A rocket borne air density system for the 100-200 km region has been designed, calibrated and flown at White Sands Missile Range to 170 km on two Nike-Iroquois rockets. The method employed utilizes emission of a 4.5 kV dc electron beam, and observation of both 1.5 to 4.5 keV X-ray breamsstrahlung and 3914 A ultraviolet radiation created by

interaction of the beam with the ambient atmosphere. A retarding potential analyzer is included to measure any charge build-up occurring on the rocket due to emission of the electron beam. Author (GRA)

N72-29660# Army Foreign Science and Technology Center, Charlottesville, Va.
USE OF THE ZAITSEV METHOD FOR DETERMINING THE WATER CONTENT OF FOGS IN CHAMBERS
A. F. Mumanenko 27 Oct. 1971 12 p refs Transl. into ENGLISH from the mono. "Primenenie Metoda Zaisteva dlya Opredeleniya Vodnosti Tumanov v Kamerakh"
(AD-741521; FSTC-HT-23-108-71) Avail: NTIS CSCL 04/2

In studying the structure of clouds and fogs, in addition to determining the drop size, the water content is measured, i.e. the mass of water in the liquid or solid phase, occurring per unit of volume of air. Of all the currently existing methods of measuring water content, the simplest and most widely used is the method of V.A. Zaytsev. In this method, the air to be examined, together with the particles of cloud or fog is directed in a narrow stream at rather high speed onto a strip of filter paper covered with dye and placed in a special holder. The air flows freely through the holder, but the drops are deposited by inertia on the paper and saturate it. A spot appears on the paper whose average diameter characterizes the magnitude of the water content.
Author (GRA)

N72-29661# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
ATHENA H-003JD, FLIGHT 133 Meteorological Data Report for 17 Mar. 1972
John M. Sharpe Mar. 1972 77 p refs
(DA Proj. 1T6-65702-D-127)
(AD-740149; DR-702) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of Athena Flight 133, Vehicle H-003JD, are presented for the Air Force Space and Missile Systems Organization and for ballistic studies. The data are presented in tabular and figure form. Author (GRA)

N72-29662# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 12803 LANCE, MISSILE NO. 2116, ROUND NO. 154 EBT (24 MARCH 1972) Meteorological Data Report for 24 Mar. 1972
Mar. 1972 34 p
(DA Proj. 1T6-65702-D-127)
(AD-740151; DR-704) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 12803 Lance, Missile Number 2116, Round Number 154 EBT, are presented in tabular form. Author (GRA)

N72-29663# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 12801 LANCE, MISSILE NO. 2140, ROUND NO. 150 EBT (3 MARCH 1972)
Mar. 1972 74 p
(DA Proj. 1T6-65702-D-127)
(AD-740150; DR-697) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 12801 Lance, Missile Number 2140, Round Number 150 EBT, are presented in tabular form. Author (GRA)

N72-29664# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE 12801 LANCE, MISSILE NO. 2126, ROUND NO. 153 EBT (21 MARCH 1972) Meteorological Data Report
Mar. 1972 68 p
(DA Proj. 1T6-65702-D-127)
(AD-740152; DR-701) Avail: NTIS CSCL 04/2

Meteorological data gathered for the launching of 12801 Lance, Missile No. 2126, Round No. 153 EBT, are presented in tabular form. Author (GRA)

N72-29665# Air Force Packaging Evaluation Agency, Wright-Patterson AFB, Ohio.
EVALUATION OF MIL-I-26860 HUMIDITY INDICATORS Final Report, 24 Jan. - 11 Feb. 1972
William R. Drake Feb. 1972 16 p refs
(AD-740896; DSPS-72-2) Avail: NTIS CSCL 04/2

A series of tests intended to determine the reliability of humidity indicators procured under MIL-I-26860, Indicator, Humidity, Plug, Color Change, and taken from service at the Military Aircraft Storage and Disposition Center were conducted.
Author (GRA)

N72-29666# Army Engineer Topographic Labs., Fort Belvoir, Va.
THE DERIVATION AND POTENTIAL OF NEW FILTER EQUATION FOR NUMERICAL WEATHER PREDICTION
Hans BaussusvonLuetzow Dec. 1971 37 p refs
(AD-741788; ETL-RN-71-3) Avail: NTIS CSCL 04/2

The research presents two initialization methods in the form of optimal filter equations suitable for adiabatic and diabatic numerical weather prediction and an optimal system of equations for numerical weather prediction involving four prognostic equations and one diagnostic equation. Author (GRA)

N72-29667# West Indies Univ., Kingston (Jamaica). Dept. of Physics.
A STUDY OF THE FEASIBILITY OF MEASURING ATMOSPHERIC DENSITIES BY USING A LASER SEARCHLIGHT TECHNIQUE Final Report, 1 Apr. 1964 - 30 Jun. 1971
G. S. Kent, W. Keenliside, M. C. W. Sandford, M. Ottway, and R. W. H. Wright Feb. 1972 76 p refs
(Grant AF-AFOSR-0616-67; AF Proj. 6682)
(AD-741875; AFCRL-72-0167) Avail: NTIS CSCL 04/2

The report summarizes the work done during the period between April 1964 and June 1971 in developing and testing a laser radar technique to obtain backscattered signals from the atmosphere at altitudes up to 100 km. A vertically directed pulsed ruby laser signal with a 10 joule, 10 microsecond pulse provided the transmitted energy and an array of 30 inch diameter spherical mirrors provided a mirror area of 15 square meters to collect the backscattered energy. Photon counting techniques were utilized for high altitude returns and many returns are integrated to provide high sensitivity and to reduce the variance of the signals. Author (GRA)

N72-29668# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
TEMPERATURE SOUNDING UP TO 2 km: A REVIEW OF TECHNIQUES Interim Report
Arnold A. Barnes, Jr. 3 Apr. 1972 7 p refs
(AF Proj. 8628)
(AD-742330; AFCRL-72-0214) Avail: NTIS CSCL 04/2

A review of all techniques for obtaining temperature soundings of the lower few kilometers of the atmosphere was undertaken in order to find suitable, reliable methods for obtaining comparison soundings and to educate ourselves concerning the accuracy and operating difficulties associated with these methods. The first section deals with measuring sensors which are imbedded in the atmosphere (mercury thermometers, thermistor rods, beads, etc.) to obtain the atmospheric temperature. Various means of placing these sensors in the atmosphere, such as balloons, towers, aircraft, rockets, kytoons, microwave levitation, etc. are discussed in the second section. The third section is concerned with other methods of obtaining temperature soundings; these methods can best be classified as indirect. Author (GRA)

N72-29669# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
CLIMATOLOGY OF APPALACHIAN VALLEY FOG AT WHITE SULPHUR SPRINGS, WEST VIRGINIA, AND NEARBY

STATIONS DURING MONTHS OF PEAK FOG FREQUENCY Environmental Research Papers
Alfred A. Spatola 21 Jan. 1972 52 p refs
(AF Proj. 7605)
(AD-741756; AFCRL-ERP-382; AFCRL-72-0054) Avail: NTIS CSCL 04/2

The study provides a summary of the characteristics of radiation fog of the Appalachian valley type at the Greenbrier Airport, White Sulphur Springs, West Virginia. Author (GRA)

N72-29363* Bureau of Mines, Pittsburgh, Pa.
THE REMOTE SENSING OF AIR POLLUTION FROM COAL UTILIZATION
Brian M. Harney, Donald H. McCrea, and Albert J. Forney *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 14 p refs Original contains color illustrations (For availability see N72-29355 20-13)
CSCL 04B

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N72-29670*# Ball Bros. Research Corp., Boulder, Colo.
FABRICATION AND TEST OF EIGHT SETS OF STRAP 3 FLIGHT HARDWARE Final Report
M. E. Greeb 15 Mar. 1972 110 p
(Contract NAS5-11664)
(NASA-CR-122516; F72-03) Avail: NTIS HC $7.50 CSCL 17G

The development and characteristics of the Stellar Tracking Rocket Attitude Positioning (STRAP) system are discussed. The objective of the program was to produce eight sets of reliable flight hardware at a cost that was compatible with the typical sounding rocket mission. The flight system consists of: (1) the attitude control system, (2) the pneumatics systems components, and a fine guidance error sensors star tracker. The performance of the system and the areas where improvements are needed are examined. Line drawings and circuit diagrams are presented to amplify the accomplishments of the project. P.N.F.

N72-29671# Federal Aviation Agency, Oklahoma City, Okla.
EVALUATION OF APPROACH PROCEDURES FOR ILS BACK COURSE WITH GLIDE SLOPE Final Report
Allan W. Hunting Jul. 1972 36 p ref
(FAA-FS-600-8) Avail: NTIS HC $4.00

An operational evaluation was performed to compare ILS back course approaches with front course approaches in an effort to determine flyability problems associated with back course ILS with glide slope and the appropriate obstacle clearances to be applied. Simulated approaches were flown in the B720 flight simulator. Hooded approaches were flown in 6 different aircraft. Facility and airborne systems include back and front courses; localizer only and localizer with glide slope; normal and reverse course sensing. All were flown using raw ILS data for guidance. A questionnaire was filled out on each subject pilot at the end of his runs. Heights above touchdown at which ILS guidance became unusable were computed from simulator tracings and data logs. It was found that the established ILS obstacle clearance criteria for front course ILS approaches with glide slope is adequate for back course approaches with glide slope. Author

N72-29672# National Aviation Facilities Experimental Center, Atlantic City, N.J.
COLLISION AVOIDANCE: AN ANNOTATED BIBLIOGRAPHY, SEPTEMBER 1968 - APRIL 1972 Final Report, 1968 - 1972
Dorothy E. Bulford, comp. Aug. 1972 267 p refs
(FAA-NA-72-41) Avail: NTIS HC $15.50

In November 1968 a bibliography consisting of 1013 references without annotations was issued as FAA report number NA-68-54. This present work supplements that report. In addition to the subject and corporate author indexes of the 1968 listing, this bibliography includes a personal names index which will help find secondary authors or locate names mentioned in titles and abstracts. Author

N72-29673# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et de ses Applications Spatiales.
REPORT ON WORK PERFORMED UP TO 22 DECEMBER 1971 ON THE PNEUMATIC PLATFORM [COMPTE RENDU DES TRAVAUX EFFECTUES SUR LA TABLE A AIR AU 22 DECEMBRE 1971]
G. Bauzil and G. Vialaret 1971 76 p In FRENCH
(LAAS-NI-MCI-71-07) Avail: NTIS HC $6.00

A recently obtained second hand satellite control simulator is described, and improvements to the system are discussed. They include design of a device for measuring the oscillation frequency of the satellite mock-up, design of a solar sensor with its electronic circuits, measurement of different light sources to be used as reference sources, simulation of the readjustment of kinetic momentum, design of a pitch velocity regulator, adjustment of an analog computer to the characteristics of the mock-up, and design of balance procedures. ESRO

N72-29674# Societe d'Etudes des Systemes d'Automation, Paris (France).
SUPPLEMENT TO THE THEORETICAL STUDY OF SATELLITE AIR TRAFFIC CONTROL SYSTEMS. SIMULATION OBJECTIVES FOR SYSTEM INTEGRATION Final Report [COMPLEMENT A L'ETUDE THEORIQUE DE SYSTEMES DE CONTROLE DE LA CIRCULATION AERIENNE PAR SATELLITES. OBJECTIFS DE SIMULATION POUR L'INTEGRATION DU SYSTEME. RAPPORT FINAL]
26 Apr. 1972 176 p In FRENCH
(Contract ESTEC-1377/71-CG)
(SESA-Ex-5072-15.786/72; ESRO-CR(P)-103) Avail: NTIS HC $11.00

Arrangements proposed for the pre-operational simulation of air traffic control and message management for the ESRO Aerosat project are presented. A simulation plan is proposed which is to be developed in parallel with the hardware availability. Ten different stages are analyzed, with the introduction of new elements at each stage, to realize a program that will support full transatlantic air traffic control including extension of the zone covered; eastbound, westbound flights in both directions, full load or reduced load of circuits; subsonic or supersonic aircraft; present or reduced distance between flying aircraft and taking into account failures of the system. Specifications for the software to be developed are listed and the characteristics of the computer required are evaluated. ESRO

N72-29675# Avco Corp., Wilmington, Mass.
FERROFLUID GYRO Technical Report, 2 Nov. 1970 - 1 Nov. 1971
Gabor Miskolczy and Rudolph Little Wright-Patterson AFB, Ohio AFFDL Nov. 1971 55 p refs
(Contract F33615-71-C-1060; AF Proj. 8222)
(AD-740875; AVSD-0093-72-RR; AFFDL-TR-71-129) Avail: NTIS CSCL 17/7

The concept of using a ferrofluid rotating under the influence of an electromagnetic field as a gyroscope is reported. A ferrofluid is a colloidal suspension of ferromagnetic particles and behaves as a magnetic liquid. It was shown that up to about 100 dyne-cm/cc of torque can be transmitted at rates of about 5 KHz using a field strength of about 80 oersted. The direction

of the torque was observed to be opposite to the rotation of the surface layer of the fluid, indicating a complex flow pattern in the interior. In a dynamic experiment a signal from a search coil surrounding the rotating ferrofluid was less than 2 microvolts/milliradian, when the system was subjected to angular rates of about 150 degrees/sec. Author (GRA)

N72-29676# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AIR TRAFFIC CONTROL Quarterly Technical Summary, 1 Nov. 1971 - 31 Jan. 1972
Herbert G. Weiss 15 Feb. 1972 19 p refs
(Contract F19628-70-C-0230)
(AD-740877; ESD-TR-72-57) Avail: NTIS CSCL 17/7

The report summarizes the progress on Air Force funded tasks within the Division between 1 November 1971 and 31 January 1972. The four areas under investigation are: radar MTI technology, airborne graphical displays, the influence of propagation effects on CNI system performance and the analysis of various microwave landing guidance systems. Author (GRA)

N72-29677# Army Missile Command, Redstone Arsenal, Ala.
DIGITAL REDESIGN OF PERSHING ATTITUDE CONTROL SYSTEM
Sherman M. Seltzer 29 Nov. 1971 20 p refs
(DA Proj. 1X2-22254-D-678)
(AD-740648; RG-TN-71-4) Avail: NTIS CSCL 16/4

In the report the revised technique for designing a tactical rocket attitude control system has been extended and applied to the redesign of a continuous control system. The original Pershing weapon system attitude control system was implemented by an analogue flight computer which has been replaced by a digital flight computer. The report presents a design technique for designing a digital attitude control system for the Pershing weapon system. The design goal is to match the digital system response to that of the original analogue system. Author (GRA)

N72-29678# Army Missile Command, Redstone Arsenal, Ala.
DIGITAL REDESIGN OF A ROCKET ATTITUDE CONTROL SYSTEM, PART 2
Sherman M. Seltzer 30 Nov. 1971 16 p ref
(DA Proj. 1X2-22254-D-678)
(AD-740647; RG-TN-71-5) Avail: NTIS CSCL 16/4

A technique which enables a designer to perform digital redesign of an existing continuous control system has been expanded by Professor Benjamin C. Kuo of the University of Illinois to enable digital redesign of a forced control system. The report presents a brief description of the newly expanded technique and includes an example of its application.
Author (GRA)

N72-29679# Defense Documentation Center, Alexandria, Va.
HOMING DEVICES Report Bibliography, Apr. 1954 - Oct. 1971
May 1972 117 p refs
(AD-741500; DDC-TAS-72-33) Avail: NTIS CSCL 17/7

The references cover use of homing devices in guided missiles, antitank projectiles, aircraft equipment, and parachute descents. Infrared detectors and sensors are discussed. Homing devices refer to radar homing, radio homing, heat homing, light homing, and proportional navigation. Also discussed are reliability, research and development, guidance and control systems, performance capabilities, and effectiveness of homing devices.
Author (GRA)

N72-29680# Defense Documentation Center, Alexandria, Va.
AIR TRAFFIC CONTROL SYSTEMS Report Bibliography, Jan. 1969 - Dec. 1971
May 1972 156 p refs
(AD-741200; DDC-TAS-72-25-1) Avail: NTIS CSCL 17/7

Air Traffic Control Systems in the bibliography relate to air traffic control centers, air traffic control operators, communication systems, computer applications, display systems, approach and landing systems, navigational aids, human factors, radar approach control, decision making and systems value engineering. Corporate Author-Monitoring Agency, Subject, Title, and Personal Author Indexes are included. GRA

N72-29681# Air Force Packaging Evaluation Agency, Wright-Patterson AFB, Ohio.
MONITORING THE SHIPPING ENVIRONMENT OF THE GCA/MRAPCON SYSTEM Interim Report
Randle E. Dukes Apr. 1972 21 p
(AF Proj. 68-28-C-19)
(AD-741748; DSPT-43) Avail: NTIS CSCL 17/7

The report provides the shock and vibration data collected in monitoring the shipping and handling conditions experienced in air transporting a GCA/MRAPCON vanized electronic system from SMAMA to Rhein-Main, Germany. Recorded data obtained from the shipment continues to indicate, as noted in a previous report, that the major damage potential in terms of shock occurs during loading and unloading operations with insignificant shock inputs occurring during transit. Based on the results of the test data and observed handling during loading and unloading, it is concluded that airlift is a suitable mode of transporting the vanized electronic systems. Author (GRA)

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N72-29682*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EMITTER SURFACE TEMPERATURE DISTRIBUTION FOR A MINIATURE THERMIONIC DIODE
Richard B. Lancashire, Eugene J. Manista, James F. Morris, and Arthur L. Smith Washington Aug. 1972 6 p ref
(NASA-TM-X-2588; E-6961) Avail: NTIS HC $3.00 CSCL 09A

Brightness temperatures have been observed from five hohlraums equally spaced on a diameter of a 0.635 cm thermionic emitter surface. The hohlraums are 0.0381 cm in diameter and are 0.114 cm deep. The surface was mounted in a simulated diminiode geometry and was heated from the backside, according to the design, by electron bombardment. Several temperature observations were made at each hohlraum at four different levels of input power. Within experimental error no measurable temperature gradients across the emitter surface were observed at any input power level. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N72-29683# Department of Energy, Mines and Resources, Ottawa (Ontario).
ANALYSIS OF UNITS IN ELECTROMAGNETISM
F. Primdahl Charlottenlund Danish Meteorological Inst. 1971 26 p refs Repr. from Earth Phys. Branch, v. 42, no. 1 Sponsored in part by NRC
(R-23) Avail: NTIS HC $3.50

To define a system of electromagnetic units uniquely, six basic quantities must be chosen. Maxwell's equations are derived in a general form, independent of any particular choice of the six basic quantities. It is shown that the MKSA-formulation of the field equations involves three different unit systems. In the relation B = mu sub 0 H, the symbols B and H are called a Giorgi-pair; other Giorgi-pairs are shown to exist in the MKSA-formulation of electromagnetic theory. Although of different dimensions, the members of a Giorgi-pair always describe the same physical phenomenon, and may thus be used arbitrarily, provided the Haines rule is observed. The general form of Maxwell's equations is derived for material bodies. It is shown that the MKSA-formulation uses two conflicting models for polarizable materials, leading to two electric and two magnetic fields, and the introduction of two units for each field in order to remove the constants from Maxwell's equations. Author

N72-29684# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
[PULSE SHAPES AND DISTORTIONS IN MISMATCHED SECOND HARMONIC GENERATION]
Jean-Michel Thomas and Jean-Pierre Taran 1972 12 p refs
(ONERA-TP-1066) Avail: NTIS HC $3.00

Summaries are given of the effects of pulse distortion, pulse shapes, and phase and group velocity mismatch in second harmonic generation. Problem solving techniques, including numerical methods and partial differential equations, are given. For individual titles, see N72-29685 through N72-29686.

N72-29685 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
PULSE DISTORTIONS IN MISMATCHED SECOND HARMONIC GENERATION
Jean-Michel Thomas and Jean-Pierre Taran *In its* Pulse Shapes and Distortions in Mismatched Second Harmonic Generation 1972 6 p refs Repr. from Opt. Commun. (Netherlands), v. 4, no. 5, Jan. 1972 p 329-334 (For availability see N72-29684 20-23)

The self-phase modulation of intense picosecond pulses in the course of second harmonic generation is investigated. The effect is found to be present for a phase mismatched interaction; it is associated with an amplitude modulation of the second harmonic pulse. Observable spectral broadenings of the fundamental and harmonic radiations are predicted for propagation in KDP. Author

N72-29686 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THE INFLUENCE OF PHASE-MISMATCH ON PULSE SHAPES IN SECOND HARMONIC GENERATION
Jean-Pierre Taran and Jean-Michel Thomas *In its* Pulse Shapes and Distortions in Mismatched Second Harmonic Generation 1972 5 p refs (For availability see N72-29684 20-23)

The problem of phase velocity mismatch with group velocity mismatch is discussed. General equations pertaining to phase and group velocity mismatch, together with a description of some aspects of this interaction, are given. Numerical calculations for realistic values of the experimental parameters are included. Author

N72-29687*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE MOLECULAR BRANCHING RATIO METHOD FOR CALIBRATION OF OPTICAL SYSTEMS IN THE VACUUM ULTRAVIOLET
Michael J. Mumma Jul. 1972 29 p refs Submitted for publication
(NASA-TM-X-65975; X-691-72-245) Avail: NTIS HC $3.50 CSCL 20F

The intensity distribution of bands belonging to six molecular band systems is discussed with special emphasis on their usefulness for intensity calibration of optical systems in the vacuum ultraviolet (1000A < Lambda < 3000A). The theory of molecular band intensities is outlined and the technique of measuring the spectral response curve is described. Several methods for establishing an absolute intensity calibration are discussed. Author

N72-29688# Tyco Labs., Inc., Waltham, Mass.
ELECTRO OPTIC LIGHT MODULATOR MATERIAL BY THM Semiannual Technical Report, 15 Jul. 1971 - 14 Jul. 1972
Fritz V. Wald, Richard O. Bell, and Andrew A. Menna Hanson Field, Mass. AFCRL Jan. 1972 25 p refs
(Contract F19628-72-C-0011; ARPA Order 1434; AF Proj. 5620)
(AD-740488; C-203; AFCRL-72-0119; SATR-1) Avail: NTIS CSCL 20/6

The experimental work discussed in the report is mostly concerned with the synthesis of the 2-4 V2 compounds, and the regrowth of the synthesized material by the traveling heater method (THM). Efforts to grow cinnabar by THM were continued with some success. Hydrothermal growth of cinnabar has been started. It is planned to continue a run for 2 to 3 months. Work on Bi4T13O12 was continued. Author (GRA)

N72-29689*# National Academy of Sciences-National Research Council, Washington, D.C. Physics Survey Committee.
PHYSICS IN PERSPECTIVE: RECOMMENDATIONS AND PROGRAM EMPHASES
1972 125 p refs
(Contract NSR-09-012-090)
(NASA-CR-127782) Avail: NTIS HC $8.25 CSCL 20H

Exerpted material from Physics in Perspective, Vol. 1, is presented on recommendations, priorities, and program emphases. The major recommendations are addressed to the Federal Government and support agencies, the physics community, and the educational community, including precollege, undergraduate, and graduate sectors. Approaches to the questions involved in establishing scientific priorities are discussed, and an approach is evolved which is based on the jury rating application of certain criteria to the program elements of a subfield. The question of national support level for the physics enterprise is also considered, and contingency alternatives are suggested such that whatever the level of available support, it may be used with maximum effectiveness. N.E.N.

N72-29690*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RELATIVISTIC TIME CORRECTIONS FOR APOLLO 12 AND APOLLO 13
John E. Lavery Washington Aug. 1972 14 p refs
(NASA-TN-D-6681; E-1049) Avail: NTIS HC $3.00 CSCL 22C

Results are presented of computer calculations on the relativistic time corrections relative to a ground-based clock of on-board clock readings for a lunar mission, using simple Newtonian gravitational potentials of earth and moon and based on actual trajectory data for Apollo 12 and Apollo 13. Although the second order Doppler effect and the gravitational red shift give rise to corrections of opposite sign, the net accumulated time corrections, namely a gain of 560 (+ or - 1.5) microseconds for Apollo 12 and gain of 326 (+ or - 1.3) microseconds for Apollo 13, are still large enough that with present day atomic frequency standards, such as the rubidium clock, they can be measured with an accuracy of about + or - 0.5 percent. Author

N72-29691# California Univ., Berkeley. Lawrence Berkeley Lab.
[EXPERIMENTAL AND THEORETICAL NUCLEAR RESEARCH] Annual Report
1971 198 p refs
(Contract W-7405-eng-48)
(LBL-40) Avail: NTIS

Research progress is outlined in the fields of experimental and theoretical high energy physics, health physics, computing and data handling, and accelerator technology. Publications issued during the period are listed. NSA

N72-29692# Ohio State Univ., Columbus. Dept. of Metallurgical Engineering.
PROPOSED ULTRAVIOLET BAND FILTERS
D. L. Olson and D. A. Rigney [1972] 15 p refs Sponsored by AEC
(COO-2037-12) Avail: NTIS

The ultraviolet transmission characteristics of selected alkali metal alloys are presented, and a scheme for constructing simple ultraviolet band filters is described. Author

N72-29693# Institut fuer Plasmaphysik G.m.b.H., Garching (West Germany).
STIGMATIC FOCUSING HOMOGENEOUS MAGNETIC SECTOR FIELDS
W. Eckstein and H. Verbeek Jan. 1972 29 p refs In GERMAN; ENGLISH summary Sponsored in part by EURATOM
(IPP-9/1) Avail: AEC Depository Libraries

For homogeneous magnetic sector fields with deflection angles of 30, 40, 45, 50, 60, 70, 80, 90, 100 and 110 deg with the condition of stigmatic focusing, the possible combinations of the entrance and exit angles and the focusing lengths were calculated. In a separate bound appendix, the magnifications, the dispersion, and the resolving power are plotted. Author (NSA)

N72-29694# Lamont-Doherty Geological Observatory, Palisades, N.Y.
FURTHER INVESTIGATION OF THE INTEGRAL SOLUTION OF THE SOUND FIELD IN MULTILAYERED MEDIA. A LIQUID-SOLID HALF SPACE WITH A SOLID BOTTOM
Henry W. Kutschale Mar. 1972 73 p refs
(Contract N00014-67-A-0108-0016; NR Proj. 307-320)
(AD-740363; TR-6) Avail: NTIS CSCL 20/1

The integral solution of the sound field is derived from a laminated interbedded liquid-solid half space. The last layer of infinite thickness is solid. The integral over wave number is conveniently transformed into the complex wave number plane yielding a sum of normal modes of propagation plus the sum of integrals along branch cuts. Waves corresponding to the normal modes predominate at ranges beyond several times the water depth and are considered in detail. Sample numerical computations are presented for propagation of Rayleigh waves in shallow water on the Arctic continental shelf. Author (GRA)

N72-29695# Radio Corp. of America, Princeton, N.J.
STRONG AMPLITUDE FLUCTUATIONS OF WAVE FIELDS PROPAGATING THROUGH TURBULENT MEDIA
David A. deWolf Feb. 1972 78 p refs
(Contract F30602-71-C-0356; ARPA Order-1279)
(AD-740632; RADC-TR-72-51; PPRL-72-CR-11) Avail: NTIS CSCL 20/6

A fundamental problem in laser-beam propagation through air is to determine the statistics of the fluctuating irradiance. To date this problem is still unsolved in the strong-optics regime (where scintillation is appreciable). This work presents an exhaustive survey, correction, and expansion of the results that can be obtained through selective summation of averaged products of Born-series terms substituted for the electric field in the average field, the mutual-coherence factor, and the N-th moment of the irradiance. Detailed error analyses and regimes of validity are provided. Author (GRA)

N72-29696# Naval Postgraduate School, Monterey, Calif.
DIMENSIONAL ANALYSIS AND THE CONCEPT OF NATURAL UNITS IN ENGINEERING
T. H. Gawain Mar. 1972 73 p refs
(AD-741065; NPS-57Gn72031A) Avail: NTIS CSCL 14/2

The monograph presents an introduction to dimensional analysis, a subject of profound significance for all quantitative sciences and engineering. Although the purely formal mathematical relations of dimensional analysis can be found in many texts, the present analysis, while still reasonably brief, goes well beyond the usual textbook treatment. It develops a unified theory of physical measurements which involves several novel and original features. Engineering applications of the theory are illustrated by various examples involving mainly fluid flow, turbomachinery, propellers, and related devices. In broad classes of propellers, lifting rotors, and air turbines, merely by nondimensionalizing the well known momentum/energy relations in an unconventional but systematic manner. Author (GRA)

N72-29697# Naval Research Lab., Washington, D.C.
A FORTRAN PROGRAM FOR COMPUTING THE POWER RESPONSE OF A HYDROPHONE ARRAY TO A PLANE WAVE AND PLOTTING IT AS AN ISOMETRIC SURFACE Final Report
Leon P. LaLumiere, Jr. 17 Apr. 1972 38 p refs
(RF05552403)
(AD-741676; NRL-7392) Avail: NTIS CSCL 17/1

BEAMPLOT is a FORTRAN program designed to simulate the power response of an arbitrary, focused hydrophone array to an incoming plane wave with or without pattern multiplication as desired. It is used with a three-dimensional plot routine to display output values as a response surface. The program is useful in the study or response dependence on such factors as focal direction, delays due to hydrophone positioning, signal frequency, and hydrophone weighting. Author (GRA)

N72-29698# Airborne Instruments Lab., Deer Park, N.Y.
TEN MICROMETERS DETECTOR Semiannual Report,
E. Chiou, M. Aita, A. Vitolo, and F. Pace 31 May 1972 41 p refs
(Contract N00014-70-C-0161; APR Order 306)
(AD-741227) Avail: NTIS CSCL 20/6

An experimental model imaging upconverter using a single-mode 5-W Nd:YAG laser as the pump source has been assembled and its imaging capability measured. A linear resolution of 112 lines along the horizontal direction was obtained. The dark noise characteristics of the GFE Varian image tubes were measured. Pump laser damage to the nonlinear proustite material was considered and the bulk absorption coefficient of proustite at 1.06 micrometer was measured. Imaging upconversion with a multimode laser pump was considered analytically. Author (GRA)

N72-29699# State Univ. of New York at Buffalo. Dept. of Engineering Science.
ON CONSERVATION THEOREMS IN THE FIRST STRAIN-GRADIENT THEORY OF LINEAR ELASTICITY
Raj. K. Kaul Nov. 1971 32 p refs
(Contract N00014-71-C-0108)
(AD-741679; Rept-75) Avail: NTIS CSCL 20/10

For nonsimple materials of grade 2, strong laws of conservation which are independent of the governing field equations have been derived. Also derived are the Trautman's identity, in covariant form, laws of conservation of angular momentum and laws of conservation of linear momentum. Author (GRA)

N72-29700# Little (Arthur D.), Inc., Cambridge, Mass.
CHARACTERIZATION OF IR WINDOWS
John S. Haggerty and E. T. Peters Mar. 1972 36 p refs
(Contract N00014-72-C-0092; ARPA Order 1806)
(AD-740144; ADL-74010-1; QTR-1) Avail: NTIS CSCL 20/6

Back reflection X-ray topographic techniques have been used to characterize high resistivity GaAs single crystals. Their intended use is for high power IR windows. Initial results have revealed growth defects as well as defects induced by subsequent processing of the crystals. Strains from faceted growth were

evident in most crystals. The surfaces of polished crystal section faces exhibited damage induced during the initial cutting of the crystals as well as during the polishing procedures.
Author (GRA)

N72-29701# Texas Univ., Austin. Applied Research Labs.
FINITE-AMPLITUDE SOUND PROPAGATION IN THE FARFIELD OF NONUNIFORM SOURCES, 1. THE DIFFRACTION OF N WAVES BY A CIRCULAR APERTURE IN A PLANE BAFFLE, 2. Ph.D. Thesis - Rochester Univ.
James C. Lockwood Jul. 1971 167 p refs Prepared in cooperation with Rochester Univ., N. Y.
(Contract F44620-71-C-0015; F44620-69-C-0044; N00014-70-A-0166-0004; AF Proj. 9781)
(AD-740498; ARL-TR-71-26; AFOSR-71-1916TR) Avail: NTIS CSCL 20/1

In part 1, a solution for the farfield propagation of finite-amplitude waves from nonuniform sources is presented. This solution was obtained by applying the method of multiple scales to solve a second-order, lossless, nonlinear wave equation. The solution represents a generalization of the solution Earnshaw gave for plane waves. In part 2, a solution of the linear wave equation is presented for the diffraction of plane N waves by a circular aperture in a plane baffle. Analytical results are obtained. Because of their complexity, a computer has been used to draw the waveforms. For the case when the observation point is in the beam, the observed waveform is composed of the incident signal plus a diffracted signal. The results show that as the observation point is moved off the axis, the diffracted wave quickly degrades to a low-level signal because of the reduced coherence of the signals from the aperture edge. The theoretical results, modified to apply to an incident spherical wave, agree very well with experimental results obtained by using a spark-produced N wave incident on an aperture. Author (GRA)

N72-29702# Naval Postgraduate School, Monterey, Calif.
A STUDY OF THE INFLUENCE OF GRAVITY WAVES IN A WATER FILLED WAVEGUIDE M.S. Thesis
Rolf H. Ebert Dec. 1971 52 p refs
(AD-741123) Avail: NTIS CSCL 20/1

A simple theory is developed which describes the fluctuation of a sound signal due to the influence of a standing gravity wave in a water-filled waveguide with idealized boundary conditions. The theory predicts a strong resonance of the fluctuation if the wave length of the surface wave is one-half of the acoustic wave length. The presence of this resonance is verified experimentally.
Author (GRA)

N72-29703# Charybdis, Inc., Anaheim, Calif.
A PARAMETRIC SURVEY OF THE XENON ELECTRODELESS ARC LAMP Final Report
Donald D. Hollister, Robert E. Price, and Kim Choy Mar. 1972 98 p refs
(Contract DAAK02-71-C-0341; DA Proj. 1S6-63719-DK-70)
(AD-742255; CI-72014; ECOM-0341-1) Avail: NTIS CSCL 13/1

The study treats an experimental survey of key observable properties of the high-pressure xenon electrodeless arc lamp in which performance characteristics and operating trends of the electrodeless arc lamp are described in terms of established operating parameters. The causes of inefficiency in lamp operation were examined and methods developed successfully for improving lamp performance. Data are given which demonstrate lamp operational efficiencies approaching the theoretical maximum. The principal observed cause of electrodeless arc lamp failure is described and techniques are presented for preventing lamp failures. Author (GRA)

N72-29704# Stanford Univ., Calif. Electronics Labs.
INCREASING THE DYNAMIC RANGE OF COHERENT OPTICAL FILTERS BY MEANS OF MODULATING GRATINGS
J. W. Goodman and H. B. Struebin (CIBA-GEIGY Photochem. Ltd., Fribourg, Switz.) Mar. 1972 47 p refs
(Contracts N00014-67-A-0112-0044; N00014-76-A-0112-0023; SU Proj. 6418)
(AD-742349; SU-SEL-72-006; TR-6418-1) Avail: NTIS CSCL 20/6

The authors report on a new method for increasing the linear dynamic range of coherent optical spatial filters, with special reference to holographic image deblurring filters. Theory, computer simulations and experimental results are presented.
Author (GRA)

N72-29305* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADIOMETRIC IMAGES ON IR RESTSTRAHLEN EMISSION FROM ROCK SURFACES
Warren A. Hovis *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 13 p ref Original contains color illustrations (For availability see N72-29302 20-13)
CSCL 08G

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N72-29705*# Alabama A & M Univ., Normal. Dept. of Physics.
A COMPUTER CODE FOR PREDICTING GAMMA PRODUCTION CROSS SECTIONS BY NEUTRON INELASTIC SCATTERING FROM LIGHT NUCLEI Final Report
M. C. George Jun. 1972 45 p refs
(Grant NGR-01-001-007)
(NASA-CR-127781) Avail: NTIS HC $4.25 CSCL 20H

Gamma-ray production cross section by the inelastic scattering of neutrons from light nuclei are considered. The applicability of optical model potential is discussed. Based on experimental data, a cascade approach is developed to calculate the inelastic gamma production cross sections. In the case of O-16 using computer code LINGAP in conjunction with ABACUS-2; results are compared with reported values. Author

N72-29706*# Brown Univ., Providence, R.I.
COMPOSITION DEPENDENCE OF ION DIFFUSION COEFFICIENTS IN GAS MIXTURES AT ARBITRARY FIELD STRENGTHS
J. H. Whealton and E. A. Mason [1972] 14 p refs
(Grant NGL-40-002-059)
(NASA-CR-127784) Avail: NTIS HC $3.00 CSCL 20H

Expressions for the diffusion coefficient of ions in gas mixtures are obtained from momentum transfer theory, and are given in terms of the diffusion coefficients and drift velocities of the ions in the pure component gases. Blanc's law holds exactly at all field strengths if the mean free time between collisions is independent of velocity (Maxwell model), but otherwise there may be either positive or negative deviations from Blanc's law at high fields. Such deviations are of comparable magnitude for the diffusion coefficients and the mobility, but are not identical. Specific cases of inverse-power potentials are treated in further detail, and some numerical examples are given for rigid-sphere interactions. Author

N72-29707*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
VACUUM ULTRAVIOLET LINE RADIATION MEASUREMENTS OF A SHOCK-HEATED NITROGEN PLASMA

James O. McClenahan Washington Aug. 1972 35 p refs
(NASA-TN-D-6920; A-4234) Avail: NTIS HC $3.00 CSCL 18H

Line radiation, in the wavelength region from 1040 to 2500 A from nitrogen plasmas, was measured at conditions typical of those produced in the shock layer in front of vehicles entering the earth's atmosphere at superorbital velocities. The radiation was also predicted with a typical radiation transport computer program to determine whether such calculations adequately model plasmas for the conditions tested. The results of the comparison show that the radiant intensities of the lines between 1040 and 1700 A are actually lower than are predicted by such computer models. Author

N72-29708*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

KINEMATIC DISTRIBUTIONS FOR ELECTRON PAIR PRODUCTION BY MUONS

Ralph Linsker (Columbia Univ., N. Y.) [1972] 29 p refs Supported in part by AEC
(NASA-TM-X-68565; COO-3067(2)-2) Avail: NTIS HC $3.50 CSCL 20H

Cross sections and kinematic distributions for the trident production process plus or negative muon plus charge yields plus or minus muon plus electron plus positron plus charge (with charge = dipion moment and Fe) are given for beam energies of 100 to 300 GeV at fixed (electron positron) masses from 5 to 15 GeV. This process is interesting as a test of quantum electrodynamics at high energies, and in particular as a test of the form of the photon propagator at large timelike (four-momentum) squared. For this purpose, it is desirable to impose kinematic cuts that favor those Bethe-Heitler graphs which contain a timelike photon propagator. It is found that there are substantial differences between the kinematic distributions for the full Bethe-Heitler matrix element and the distributions for the two timelike-photon graphs alone; these differences can be exploited in the selection of appropriate kinematic cuts.
Author (NSA)

N72-29709*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE INTERACTION LENGTHS OF ENERGETIC PIONS AND PROTONS IN IRON

Hall Crannell (Catholic Univ. of America), Carol Jo Crannell (Federal City College), Haven Whiteside (Federal City College), Jonathan F. Ormes, and Michael J. Ryan Jun. 1972 38 p refs Submitted for publication
(Grants NGR-09-005-007; NGR-09-050-001)
(NASA-TM-X-65951; X-661-72-194) Avail: NTIS HC $4.00 CSCL 20H

The interaction lengths of pions and protons in iron have been measured using an ionization spectrometer composed of alternating layers of iron and plastic scintillator. These measurements cover an energy range from 9.3 to 18 GeV. The interaction lengths were determined by accurate statistical analyses of the experimental data using the maximum likelihood method. The dependence of the interaction length on the parameters used to define an interaction was studied, and the results reported employ parameters chosen to minimize the percentage uncertainty in the interaction length. The mean interaction length of pions was found to be approximately 20% greater than that of protons. Author

N72-29710# Northeastern Univ., Boston, Mass. Dept. of Physics.

PREDICTION OF A NARROW DIP AT LOW t IN THE ELECTROPRODUCTION OF NEUTRAL RHO MESON

Hyman Goldberg Jun. 1972 5 p refs
(NUB-2142) Avail: NTIS HC $3.00

By extending a geometric version of duality to the scattering of virtual photons, and by observing the dominance of non-diffractive components for omega approximately less than or equal to 10 in such processes, a very sharp dip at small t is predicted in the differential cross section for the process gamma(q sq) + p yields neutral rho meson + p. Author

N72-29711# Northeastern Univ., Boston, Mass. Dept. of Physics.

INEQUALITIES BASED ON UNITARITY AND DUALITY

Huan Lee Jun. 1972 8 p refs Sponsored by NSF
(NUB-2144) Avail: NTIS HC $3.00

Rigorous inequalities are derived which provide constraints on inclusive cross sections. In particular, they put severe limitations on the triple-Pomeron and Pomeron-particle-Pomeron vertex functions, if the Pomeron is a pole with alpha sub n(0) = 1. Also derived is a set of inequalities based on duality and their applications are discussed. Author

N72-29712# Northeastern Univ., Boston, Mass. Dept. of Physics.

SURFACE DOMINANCE IN DEEP INELASTIC ELECTRON SCATTERING

Hyman Goldberg Jun. 1972 10 p refs Sponsored in part by NSF
(NUB-2143) Avail: NTIS HC $3.00

It is shown that if a finite part of the scaling curve nu (W sub 2) (omega') at low omega' is locally dual to a set of resonances obeying a mass formula (M sub n) squared = a ± (m sub o) squared n, then the resonances which contribute must obey the peripheral condition j about root of s. Author

N72-29713# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.

ION TRANSPORT THROUGH LAYERED ION EXCHANGE MEMBRANES

Ain A. Sonin and Gershon Grossman May 1972 50 p refs
(Grant DI-14-30-2749)
(Publ-72-4) Avail: NTIS HC $4.50

The steady state transport characteristics of a family of ion exchange membranes composed of contiguous layers of anion and cation exchange materials are described in terms of a simple physical model. Membranes consisting of up to four layers are considered. Explicit analytic expressions are derived which relate the current-voltage characteristics and transport numbers to the membrane structure and to the concentrations of the bounding solutions. The current-voltage characteristics are shown to be anisotropic with respect to current direction, showing current saturation in one or both directions, depending on membrane structure. The results are compared with available data on bipolar membranes. Author

N72-29714# National Bureau of Standards, Washington, D.C. Optical Physics Div.

BIBLIOGRAPHY ON ATOMIC ENERGY LEVELS AND SPECTRA, JULY 1968 - JUNE 1971

Lucy Hagan and W. C. Martin Jun. 1972 104 p refs
(NBS-SP-363) Avail: SOD $1.00 as C 13.10:363

The bibliography contains approximately 1100 references classified by subject for individual atoms and atomic ions. A number index identifies the references. An author index is included. References included contain data on energy levels, classified lines, wavelengths, Zeeman effect, Stark effect, hyperfine structure, isotope shift, ionization potentials, or theory which gives results for specific atoms or atomic ions. Author

N72-29715# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

FREQUENCY SHIFT OF VERTICAL OSCILLATIONS INDUCED BY THE BEAM SPACE CHARGE

A. A. Glazov, V. P. Dzhelepov, V. P. Dmitrievskii, B. I. Zamolodchikov, V. V. Kolga, D. L. Novikov, and L. M. Onishchenko 1972 16 p refs In RUSSIAN
(JINR-P9-6214) Avail: AEC Depository Libraries

Experiments on the frequency shift of incoherent vertical

oscillations induced by the forces of the beam space charge in an electron model of an isochronous cyclotron are described. The experimental results are in satisfactory agreement with the existing theory of this shift mechanism. Author (NSA)

N72-29716# Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany).
TABLES OF MIE SCATTER FUNCTIONS. PART 2: MIXTURES OF ABSORBING PARTICLES [TABELLEN VON MIE-STREUFUNKTIONEN. TEIL 2: GERMISCHE ABSORBIERENDER TEILCHEN]
R. H. Giese Dec. 1971 146 p In GERMAN
(MPI-PAE/Extraterr-58) Avail: NTIS HC $9.50

Tables of Mie scattering functions were computed for mixtures of absorbing particles. The following parameters were considered: refractive index, size/wavelength, power distribution law, and scattering angle. ESRO

N72-29717# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
COLLECTIVE PHENOMENA IN A PENNING DISCHARGE IN A STRONGLY INHOMOGENEOUS MAGNETIC FIELD
N. Hopfgarten, R. B. Johansson, B. H. Nilsson, and H. Persson May 1972 50 p refs
(TRITA-EPP-72-13) Avail: NTIS HC $4.50

In an attempt to study electric field components along the magnetic field in a collisionless plasma, a pulsed Penning discharge was run in hydrogen gas of 1-.004 torr pressure. Two cathodes where located in the mirrors and an anode in the midplane of a strongly inhomogeneous magnetic mirror field. Measurements of plasma particles, cathode heating, microwave emission, time-integrated light, diamagnetic and Langmuir probe signals, and of the electrical characteristics of the discharge were performed. The measurements show that there exists in the plasma body a potential difference of 1-2 kV, distributed along the magnetic field. Part of the ions are accelerated, probably by nonlinear waves, to energies exceeding what can be attained by electrostatic acceleration in the discharge. The distribution of these accelerated ions is monoenergetic. The various observations are interpreted in terms of certain collective phenomena in the discharge. Author (ESRO)

N72-29718# European Space Research Inst., Frascati (Italy).
FURTHER IDENTIFICATIONS IN THE AR XI SPECTRUM
J. P. Connerade 1972 4 p refs Submitted for publication
Avail: NTIS HC $3.00

The argon excited spectra between the 33.8 and 36.6 A region are analyzed. The lines detected within range are presented together with their probable assignment from the literature. The ionization stage indicated for each line is based on the variation of line intensity with beam energy. ESRO

N72-29719# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.
MOTION OF ELECTRON GAS IN CONDUCTING SOLIDS
Hilmi Demiray and A. Cemal Eringen Apr. 1972 40 p refs
(Contract N00014-67-A-0151-0004; NR Proj. 064-410)
(AD-740839; TR-29; AMS-1037) Avail: NTIS CSCL 20/3

By use of the continuum theory of mixtures, a theory is presented for elastic conductors. The ionic lattice and electronic gas as separate continua constitute the members of the mixture. Balance laws and jump conditions are given, and a set of properly invariant constitutive equations are obtained and linearized. The field equations are solved for a problem of electrostatic probe, namely, a charged spherical cavity in a solid plasma. Author (GRA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N72-29720*# Stanford Univ., Calif. Inst. for Plasma Research.
MODULATIONAL INSTABILITY OF WHISTLERS IN COLD PLASMAS
A. L. Brinca Mar. 1972 20 p refs
(Grant NGL-05-020-176)
(NASA-CR-127802; SU-IPR-464) Avail: NTIS HC $3.00 CSCL 20I

The paper obtains the modulational stability spectrum of whistlers in cold plasmas taking into consideration both ion motion and relativistic effects. The unstable band is contiguous to Omega sub e/4 and, depending on the plasma density, lies above or below that frequency Omega sub e is the electron cyclotron frequency of the static magnetic field. The relevance of the instability to whistlers in the magnetosphere is discussed. Author

N72-29721# Joint Publications Research Service, Arlington, Va.
SECOND HARMONIC GENERATION IN NONUNIFORM LASER-PRODUCED PLASMA
A. V. Vinogradov and V. V. Pustovalov 8 Aug. 1972 20 p refs Transl. into ENGLISH from Generatsiya Vtoroy Garmoniki v Neodnorodnoy Lazernoy Plazme (USSR), preprint no. 63, 1972 p 1-28
(JPRS-56713) Avail: NTIS HC $3.00

The coherent second harmonic emission with electromagnetic waves striking a layer of nonuniform plasma whose density exceeds the critical is studied. Author

N72-29722*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PRESSURE AND CURRENT EFFECTS ON THE THERMAL EFFICIENCY OF AN MPD ARC USED AS A PLASMA SOURCE
Thomas J. Pivirotto 10 Jul. 1972 36 p refs Backup document for AIAA Synoptic scheduled for publication in AIAA Journal on Jan. 1973
(Contract NAS7-100)
(NASA-CR-127758) Avail: NTIS HC $4.00 CSCL 20I

Measurements of arc voltage and energy loss to the cooled electrodes of a magnetoplasmadynamic (MPD) arc, operating without an applied magnetic field, were made at chamber pressures of 26 to 950 torr, argon mass flow rates of 0.08 to 44 g/s and current of 200 to 2000 A. The resulting arc thermal efficiency varied from 22% at a chamber pressure of 26 torr to 88% at 950 torr. Thermal efficiency was only weakly dependent on arc current. It is concluded that the MPD arc operating without an applied magnetic field and at higher pressure than normally used in thruster applications is a reliable and efficient steady-state plasma source. Author

N72-29723# Paris Univ., Orsay (France). Faculte des Sciences.
EXCITATION AND AMPLIFICATION OF ACOUSTIC WAVES BY PLASMAS Ph.D. Thesis
Marc Fitaire 1971 138 p refs In FRENCH
(FRNC-TR-152; Orsay-Ser-A-720) Avail: AEC Depository Libraries

A linear theory for the excitation and amplification of acoustic waves by reactive gaseous media is presented. Beginning with the equation for the propagation of acoustic waves along sound tubes, the damping of such waves in a finite length of neutral or weakly ionized gas is evaluated. Excitation and amplification effects were established in plasmas. Acoustic waves were excited in the plasma of microwave frequency or continuous discharges by the action of a lower frequency modulated electric field, this field acting on the plasma by means

of a resonant cavity or an electrostatic probe. It was verified that the electron density of a plasma in which an acoustic wave is propagated is modulated by this wave and that the excitation term is proportional to the time derivative of the energy exchange between the electrons and the neutrals. It was found that, within the acoustic wave, the charged particles oscillate in phase with the pressure fluctuations of the neutrals. NSA

N72-29724# Paris Univ., Orsay (France).
PLASMA-BEAM INTERACTION IN AN INFINITE MAGNETIC FIELD. APPLICATION TO A RADIALLY INHOMOGENEOUS MEDIUM AND TO HARMONIC GENERATION Ph.D. Thesis
Michel Weinfeld 1971 110 p refs In FRENCH
(FRNC-TH-164; Orsay-Ser A-767) Avail: AEC Depository Libraries

A linear theory is developed for the plasma-beam interaction, the limitation of convective coupling between the slow mode of the beam and the plasma mode of the plasma being imposed. The properties of the system are covered in detail for the case of a homogeneous plasma. A radial distribution of the plasma density, represented by a Gaussian function, is introduced. It is shown that it is possible to describe an inhomogeneous system from the homogeneous medium theory, if simple analogy rules are known. A theoretical study of the generation of harmonics in the weak-turbulence approximation is developed. The experimental equipment and measurement methods are given. The results of measurements on the general characteristics of the beam-plasma medium and its propagation characteristics in the stable region are given. The experimental results are in agreement with the linear theory. The experimental study of the generation of harmonics demonstrates that the phenomenon agrees with the model presented. NSA

N72-29725# Paris Univ., Orsay (France). Faculte des Sciences.
MICROINSTABILITIES IN A PLASMA PENETRATED BY AN HF ELECTROMAGNETIC FIELD Ph.D. Thesis
Jiry Teichmann 1971 87 p refs In FRENCH
(FRNC-TH-162) Avail: AEC Depository Libraries

It is shown that an HF electromagnetic field with a dominant magnetic component can change the dielectric properties of a plasma in such a way as to totally or partially suppress most of the microinstabilities. It is also shown that the field of a righthand polarized wave propagated along the magnetic field is preferred for the efficient stabilization of loss cone type perturbations and cyclotron instabilities. It is demonstrated that the most important mechanism involved in the stabilization is the periodic displacement of the lines of force of the associated magnetic field. The effect of different HF electric components is discussed in detail. Collisions do not change the principal stabilization mechanism. It was possible to classify the microinstabilities in collisionless plasma into two groups: modes in which the dispersion is determined by the interaction between electrons and ions; such modes are very susceptible to the effects of the HF field; oscillations excited by the collective processes due to a single species of particles which are comparatively insensitive to the HF field. NSA

N72-29726# Academy of Sciences (USSR), Moscow.
INVESTIGATION OF THE OSCILLATION FREQUENCY IN THE L-1 STELLARATOR BY A CORRELATION METHOD
M. S. Berezhetskii, S. E. Grebenshchikov, I. A. Kossyi, I. S. Sbitnikova, and I. S. Shpigel 1971 43 p refs In RUSSIAN; ENGLISH summary
(NP-19257) Avail: AEC Depository Libraries

Plasma instability in magnetic collectors is of direct interest to controlled thermonuclear synthesis; this paper describes a study of large-scale long-wave oscillations in the L-1 Stellerator with the aid of a correlation method. Amplitude-time fluctuations, measurement of long-wavelength oscillations, measurement of radial domain of correlation, and the determination of azimuthal dimensions of the fluctuations and azimuthal phase velocity are discussed. It was established that in the L-1 Stellerator azimuthal modes of oscillation are determined by the structure of the vacuum magnetic field and depend on the magnitude of the field strength. NSA

N72-29727# European Space Research Inst., Frascati (Italy).
A PLASMA INSTABILITY AND THE STRUCTURE OF STARK-BROADENED HYDROGEN LINES
Hans R. Griem [1972] 9 p refs Submitted for publication
Avail: NTIS HC $3.00

Different theories, based on literature reviews, explaining the spectral line broadening observed in the hydrogen line spectra, are presented. ESRO

N72-29728# European Space Research Inst., Frascati (Italy).
NONLINEAR THEORY OF ABSOLUTE WHISTLER INSTABILITIES IN FINITE BETA PLASMAS
E. Jamin, D. Parkinson, A. Rogister, and M. Bornatici [1972] 33 p refs Submitted for publication
Avail: NTIS HC $3.75

The nonlinear evolution and stabilization of absolute whistler instabilities driven by electron pressure anisotropy and propagating obliquely to the external magnetic field in finite beta plasmas are investigated without introducing the assumption of random phases. Both in the firehose and the mirror instability regimes the pressure anisotropy relaxes quasi-linearly towards a more stable state. The nonlinear wave equation has also been obtained. It has been shown that energy is transferred by mode coupling from unstable long wavelength- to stable short wavelength- modes; these high k modes can in turn dissipate energy by Landau damping. It has been shown that increasing amplitudes inhibit the further growth of the wave in the firehose regime; a nonlinear oscillation then sets in with a maximum amplitude proportional to the linear growth rate. This behavior is confirmed by numerical integration of the equations.
Author (ESRO)

N72-29729# Stanford Univ., Calif. Inst. for Plasma Research.
INVESTIGATIONS TO DECREASE LOSSES IN MAGNETOHYDRODYNAMIC (MHD) GENERATORS Final Technical Report, 15 Sep. 1968 - 31 Jul. 1971
Robert H. Eustis, Charles H. Kruger, Morton Mitchner et al Feb. 1972 83 p refs
(Contract F33615-69-C-1171; AF Proj. 3145)
(AD-740560; SU-IPR-454; AFAPL-TR-72-15) Avail: NTIS CSCL 10/2

The research program described in the report has included work on boundary layer studies, current distribution and current leakage in MHD generators, and boundary layer diagnostics. A computer program which has been used successfully to calculate conventional turbulent boundary layers has been modified by adding the MHD terms in the momentum and energy equations. Current patterns in conducting wall generators were measured and showed good agreement with theoretical predictions for the anode. The surface-sheath voltage drop was responsible for less good agreement at the cathode. A new method which uses Faraday splitting of laser modes is suggested for the measurement of electron concentration in the boundary layer. A laser Doppler velocimeter and its applications to boundary layer velocity measurements in the Stanford generator is described.
Author (GRA)

N72-29730# Naval Research Lab., Washington, D.C.
NON-PHYSICAL SELF FORCES IN ELECTROMAGNETIC PLASMA SIMULATION ALGORITHMS Memorandum Report
Jay P. Boris and Roswell E. Lee Aug. 1972 14 p refs
(AD-740745; NRL-MR-2418) Avail: NTIS CSCL 20/9

The paper describes a simple algorithm for removing nonphysical self forces from two popular electromagnetic plasma simulation models. This algorithm also has two additional features; it considerably reduces short-wavelength noise and unwanted numerical fluctuations, and permits faster integration

of the particle orbit equations by roughly a factor of two.
Author (GRA)

N72-29731# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.
INVESTIGATIONS OF IONIC SPECIES IN HIGH PRESSURE CESIUM DISCHARGES Final Report, 1 Mar. 1971 - 29 Feb. 1972
Lorne M. Chanin 15 Apr. 1972 42 p refs
(Contract N00014-67-A-0113-0002)
(AD-741262) Avail: NTIS CSCL 20/9

Ion sampling measurements have been made on active cesium plasmas and also on decaying plasmas in helium-cesium mixtures. Comparison of experimental and calculated values of I (Cs2 (+))/I (Cs (+)) and I (Cs3 (+))/I (Cs2 (+)) as a function of normalized pressure has enabled estimates to be made of some of the ion production and loss processes. The experimental values were obtained using rf excitation to create the discharge. The calculated results were based on a simplified model of the cesium discharge. Ion counting techniques have been used to investigate the behavior of helium-cesium afterglows.
Author (GRA)

N72-29732# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
VARIOUS PLASMA-STABILIZATION METHODS FOR CONTROLLED THERMONUCLEAR FUSIONS: COMPARISON AND ANALYSIS
B. M. Ma Apr. 1972 81 p refs
(Grant AF-AFOSR-2072-71; AF Proj. 9752; ERI Proj. 895-S)
(AD-740870; ISU-ERI-AMES-72075; afosr-72-0962TR) Avail: NTIS CSCL 20/9

To improve the stability and containment time of plasma in a magnetic field, the plasma stabiliation for controlled thermonuclear fusion must be developed. The methods or principles of magnetic shear, magnetic well, dynamic, and feedback stabiliation are of primary importance and are given primary consideration. The objectives of this research are to: Review various stabilizing methods; Compare the effectiveness, advantages and disadvantages of some stabilizing methods; and Deduce from the results obtained a new idea or original method for understanding plasma instability and improving plasma stabilization.
Author (GRA)

N72-29733# McDonnell-Douglas Co., St. Louis, Mo.
A MULTIPHASIC INVESTIGATION OF AN ARGON PLASMA IN AN RF DISCHARGE AND SONIC AFTERGLOW Interim Report
Louis N. Medgyesi-Mitschang and Ray A. Hefferlin Sep. 1971 35 p refs
(Contract F19628-71-C-0024; AF Proj. 4642)
(AD-740601; MDC-Q0461; AFCRL-71-0537; SR-1) Avail: NTIS CSCL 20/9

Microwave interferometric and radiometric, optical spectrometric and thermocouple measurements of the electron density and the electron, the excitation, and the gas temperatures have been made in the active discharge and sonic afterflow of an argon plasma generated by a rf generator. The optical measurements were made in the 4000-5000 A region for discharge pressures of 60-650 Torr. Excitation temperatures in the discharge ranged between about 7000-10,000 K. The electron temperatures from the radiometer measurements were compared with the excitation temperatures. Thermocouple measurements, gas dynamic calculations and rotational spectra from traces of N2 injected in the argon indicated that the gas temperatures in the discharge and the afterglow were 2900-4400 K and 1900-3300 K, respectively, indicating a two-temperature state in both regions. Results of this investigation indicated local thermodynamic equilibrium (LTE) for all excited levels.
Author (GRA)

N72-29734# Massachusetts Inst. of Tech., Cambridge. Space Propulsion Lab.
RESEARCH ON NONEQUILIBRIUM MHD GENERATORS Annual Technical Progress Report, 1 Feb. - 31 Dec. 1970
J. L. Kerrebrock Jul. 1971 54 p refs
(Contract F33615-69-C-1226)
(AD-740572; AFAPL-TR-71-45) Avail: NTIS CSCL 10/2

A summary is presented of progress in a study of nonequilibrium generators, with emphasis on the vibrational excitation of molecular species. Experimental work on a large generator includes development of a coaxial preionizer and development of slanted electrode walls, both of which increase the power density of the generator. A three-dimensional analysis of the slanted electrode wall is also given. Finally a preliminary report is given of experimental and theoretical work on the effect of an intense radiation field, coupled to the molecules, on electrothermal instabilities.
Author (GRA)

N72-29735# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE MECHANISM OF THERMAL IONIZATION OF AIR
T. V. Bashenova and Yu. S. Lobastov 24 Jan. 1972 12 p refs Transl. into ENGLISH from "Fizicheskaya Gazodinamika Svoistva Gasov pri Vysokokh Temperaturakh" Moscow, Izd-vo Nauka, 1964 p 17-21
(AD-741501; FTD-MT-24-1393-71) Avail: NTIS CSCL 20/9

The mechanism of thermal ionization of air behind shock waves within a range of Mach 9-12 is considered on the basis of available experimental data on the adsorption of radio waves by the ionized gaseous medium. These data show that the time dependence of the absorption of radio waves is given by a curve with a maximum which corresponds to the maximum electron concentration in the nonequilibrium region. An analysis of the time necessary to attain maxima of the absorption and attenuation coefficients is presented on the basis of existing hypotheses on the mechanism of thermal ionization of air.
Author (GRA)

N72-29736# Miami Univ., Coral Gables, Fla. Plasma Physics Lab.
EXPERIMENTAL MEASUREMENTS OF FORCE FREE COLLINEAR PLASMOIDS PRODUCED BY A CONICAL THETA PINCH
Eugene Ellis Nolting Aug. 1971 215 p refs
(Grant AF-AFOSR-0844-67; AF Proj. 9752)
(AD-741869; AFOSR-71-2905TR) Avail: NTIS CSCL 20/9

A discussion of an experimental study performed on the TRISOPS plasma device is given. The TRISOPS experiment uses two conical theta pinch guns to heat the plasma. A brief history of the theoretical principles on which the experiment is based is presented, followed by a discussion of the experimental work. This work is divided into three parts. The first part constitutes a detailed description of the experimental device. Experimental parameters are investigated and the effect of these parameters on the plasma is described. The second part contains the study of plasma produced by a single gun. Strong experimental evidence is given to support a force-free, collinear plasma theory. The third part presents the results of studies of colliding plasmoids. Experimental evidence of a deep magnetic well in the external guide field, formed by currents flowing in the plasma, is given. The size of the well as a function of experimental parameters is discussed. Use of the force free, collinear model in discussing the observed interaction supports the model.
Author (GRA)

N72-29737# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
GENERAL PHYSICS, PLASMA DYNAMICS, AND COMMUNICATION SCIENCES AND ENGINEERING Quarterly Progress Report
H. J. Zimmermann, G. G. Harvey, and S. J. Mason 15 Apr. 1972 215 p refs
(Contract DAAB07-71-C-0300)
(AD-742426; QPR-105) Avail: NTIS CSCL 20/9

Contents: Molecular beams; Microwave spectroscopy; Radio astronomy; Solid-state microwave electronics; Gravitation research; Electrodynamics of media; Plasmas and controlled nuclear fusion; Applied plasma research; Speech communication; Linguistics; Cognitive information processing; Communications biophysics; Signal processing. GRA

N72-29738# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
AN ARTIFICIAL TRANSMISSION LINE FOR STUDIES OF TRANSIENT PROPAGATION IN PLASMA MEDIA
John D. Antonucci 24 Jan. 1972 62 p refs
(AF Proj. 5635)
(AD-741754; AFCRL-PSRP-475; AFCRL-72-0055) Avail: NTIS CSCL 20/9

A lumped circuit transmission line which simulates a plasma was developed. Analogies were established by comparing the equations for the propagation of voltage in the line and the propagation of electromagnetic waves in dispersive media. The network simulated the one-dimensional isotropic case in which the plasma was linear, homogeneous and lossless. Both bounded and unbounded plasmas were considered. The transient reflected and transmitted response was measured for the step carrier sine wave, the step function and the impulse inputs. Phenomena such as ringing and time delay were observed, both of which are related to the plasma frequency. Methods of obtaining plasma slab thicknesses were also investigated. Author (GRA)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N72-29739# Defense Documentation Center, Alexandria, Va.
CdS CRYSTALS Report Bibliography, Mar. 1961 - Jan. 1962
May 1972 537 p refs
(AD-742200; DDC-TAS-72-36) Avail: NTIS CSCL 20/12

The references in this bibliography on cadmium sulfides cover the whole range of studies from the crystal growth, to the physical properties, to the uses and limitations in semiconductors, and the electronic interactions and configurations. Corporate Author-Monitoring Agency, Subject, and Title Indexes are included. Author (GRA)

N72-29740# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
DAMPING OF DISLOCATION MOTION BY CONDUCTION ELECTRONS IN METALS
K. M. Jassby and M. Shull [1972] 15 p refs Sponsored in part by NSF
(Contract AT(04-3)-767)
(CALT-767-P-3-23) Avail: NTIS

The rate of energy absorption from a moving dislocation by conduction electrons is recalculated using the semiclassical Boltzmann transport equation and the model of a free electron gas. Temperature independent values of the electronic damping coefficients B(edge) and B(screw) for edge and screw dislocations are found where B(edge) and B(screw) are similar in magnitude. The results are compared to previous work by Kravchenko and Brailsford. Author

N72-29741# Naval Ordnance Lab., White Oak, Md.
INDEPENDENT RESEARCH, 1971 Research Report, 1 Jul. 1970 - 1 Jul. 1971
D. F. Beil 1 Jul. 1971 153 p refs
(AD-740317; NOLR-1283) Avail: NTIS CSCL 14/2

The report gives an up-to-date account of active research tasks. These tasks fall into the following categories: solid state physics, metallurgy, electromagnetic interaction with atoms and molecules, intense radiation, smoke and fire, field theory, elementary particles, liquid state, superconductivity, applied mathematics and computer sciences, fluid flow theory, thermodynamics of high temperatures, high-speed gas flows, earth re-entry body problems, explosive chemistry, deflagration to detonation, properties of solids under explosive loading, chemistry of high energy compounds, nuclear chemistry, and electrochemistry for power sources. Author (GRA)

N72-29742# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center.
ELECTRO-OPTIC PROPERTIES AND MODULATOR APPLICATIONS OF CADMIUM TELLURIDE Interim Report
M. Neuberger Feb. 1972 27 p refs
(Contract DSA900-72-C-1182)
(AD-740207; EPIC-IR-75-Rev) Avail: NTIS CSCL 20/12

Cadmium telluride is a valuable material for CO2 laser modulators because of its superior electro-optic characteristics and its low optical absorption coefficient in the infrared. In addition to data on these properties, this report provides physical, mechanical, crystallographic, thermal and relevant optical data. Thirty-two references and thirty-eight citations and informative abstracts are provided. Author (GRA)

N72-29743# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center.
THE 4-6 TERNARY SEMICONDUCTING COMPOUNDS, DATA TABLES
M. Neuberger Mar. 1972 91 p
(Contract DSA900-72-C-1182)
(AD-740208; EPIC-S-16) Avail: NTIS CSCL 20/12

The group IV-VI ternary semiconducting compounds (the lead, tin, germanium chalcogenides) are of technological device importance as photovoltaic detectors in the infrared, injection electroluminescent diodes and lasers. These tables include the most reliable property information available to date for these compounds, including mechanical, crystallographic, physical, thermal, magnetic, electronic and optical data. Included also are tables on the IV-VI quarternary compounds. Author (GRA)

N72-29744# Manlabs, Inc., Cambridge, Mass.
PHYSICAL CHARACTERIZATION OF ELECTRONIC MATERIALS, DEVICES AND THIN FILMS Technical Reports, 1 Dec. 1970 - 1 Dec. 1971
S. Andrew Kulin and Konstantin Kreder 1 Dec. 1971 34 p
(Contract F19628-70-C-0140; AF Proj. 5620; AF Proj. 5635)
(AD-740590; AFCRL-72-0067; SR-2) Avail: NTIS CSCL 20/12

Research is directed toward the characterization of specified physical, chemical and structural properties of various materials. Experimental methods include chemical analysis, reflection electron microscopy and diffraction, X-ray diffraction and fluorescence analysis, light microscopy and electron microprobe analysis, in addition to the determination of specific properties, such as density, hardness and thermal conductivity. Special services, such as crystal orientation, cutting, grinding and polishing are also being performed. A variety of specimens have been submitted for specific studies such as phase identification, crystallinity and chemical analysis. Author (GRA)

N72-29745# Northwestern Univ., Evanston, Ill. Dept. of Physics.
PHONON SCATTERING AND TRANSPORT PROPERTIES AT LOW TEMPERATURES Final Report, 8 Mar. 1968 - 31 Aug. 1971
Charles T. Walker 1972 15 p refs
(Contract DA-31-124-ARO(D)-330)
(AD-740221; AROD-5285-9-P) Avail: NTIS CSCL 20/12

Research is reported on Raman scattering and infrared absorption in insulators, second sound in solids, and low

temperature thermal conductivity of magnetic materials.
Author (GRA)

N72-29746# Boeing Co., Seattle, Wash. Aerospace Group.
A NEW TECHNIQUE TO DETERMINE AMORPHOUS STRUCTURE USING X-RAY ABSORPTION FINE STRUCTURE Final Report
Dale E. Sayers 1972 120 p refs
(Contract DAHC04-71-C-0010; ARPA Order 1562)
(AD-740216; D180-14436-1; AROD-9209-4-P) Avail: NTIS CSCL 20/2

A new theory for extended X-ray absorption fine structure (EXAFS) is presented which treats EXAFS as arising from the scattering of the ejected photoelectron by atoms surrounding the absorbing atom. The surrounding atoms are treated as a system of weak point scatterers which allows the scattered waves to be calculated using standard scattering theory. These scattered waves are included in the wave function of the ejected photoelectron and this is used to calculate the dipole transition matrix element from the X-ray absorption, which gives rise to oscillations in the absorption coefficient which depends on the positions of the surrounding atoms. The final result includes scattering factor, range and temperature terms and is general enough to handle any symmetry of atoms about the absorbing atom and any polarization state of the X-rays. Author (GRA)

N72-29747# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLID STATE RESEARCH, 1972, 1 Quarterly Technical Summary Report, 1 Nov. 1971 - 31 Jan. 1972
Alan L. McWhorter 15 Feb. 1972 68 p refs
(Contract F19628-70-C-0230)
(AD-740874; ESD-TR-72-53) Avail: NTIS CSCL 20/12

The report covers in detail the solid state research work of the Solid State Division at Lincoln Laboratory for the period 1 November 1971 through 31 January 1972. The topics covered are Solid State Device Research, Quantum Electronics, Materials Research, Physics of Solids, and Microelectronics. The Microsound work is sponsored by ABMDA and is reported under that program. Author (GRA)

N72-29748# Army Foreign Science and Technology Center, Charlottesville, Va.
TORSION OF AN ELASTIC HALF SPACE WEAKENED BY A PLANE CIRCULAR CRACK
V. S. Protsenko 21 Apr. 1972 11 p refs Transl. into ENGLISH from Mekh. Tverdogo Tele (USSR), no. 6. Nov./Dec. 1969 p 67-71
(AD-741114; FSTC-HT-23-65-72) Avail: NTIS CSCL 20/11

The axisymmetrical problem of torsion of an elastic half space weakened by a circular crack from a flat circular stamp is studied. It is assumed that the crack is not loaded. The influence of the crack on the distribution of tangential forces under the stamp is studied, as well as the problem of concentration of tangential stresses as the edges of the crack are approached. The problem is solved by the paired integral equations method. Author (GRA)

N72-29749# California Univ., Los Angeles. Dept. of Physics.
ANISOTROPIC BEHAVIOR OF DILUTE Au:Dy ALLOYS: OBSERVATION OF THE GAMMA 8 (QUARTET) RESONANCE
L. J. Tao, D. Davidov, R. Orbach, and E. P. Chock 15 Nov. 1971 4 p refs
(Contract N00014-69-A-0200-4032; NSF GP-17014)
(AD-740521) Avail: NTIS CSCL 20/12

In the report the authors describe the first observation of a Gamma (8) (quartet) resonance in a metal (Au - Dy). The field for resonance determines the relative magnitude and sign of the crystal-field parameters, B4/B6–1300 plus or minus 30, to be compared with that found for Ag - Dy alloys, = or < 340. The linewidth yields an exchange-coupling parameter J(fs) = 0.14 plus or minus 0.05 eV, slightly larger than for Au - Gd and Au - Er alloys, and slightly smaller than for silver-based alloys.
Author (GRA)

N72-29750# Auburn Univ., Ala. Dept. of Physics.
SECOND BREAKDOWN AND DAMAGE IN SEMICONDUCTOR JUNCTION DEVICES Final Report
Paul B. Budenstein, Duane H. Pontius, and Wallace B. Smith Apr. 1972 176 p refs
(Contract DAAH01-71-C-0708)
(AD-740226) Avail: NTIS CSCL 09/1

The nature of second breakdown in junction devices and the relationship between second breakdown and damage are investigated both experimentally and theoretically. The experiments were performed on silicon-on-sapphire diodes using the stroboscopic method of Sunshine. Diodes of different geometry and different base doping were included so the effects of these parameters on second breakdown could be determined. The stroboscopic technique allows the temperature configuration over the diode to be determined with a spatial resolution of several microns and a temporal resolution of about 20 ns. Second breakdown can be shown to involve three stages: nucleation of a filament, growth of a relatively broad filament across the high-resistivity region, and growth of a second filament interior to the first wherein material is in a molten state. Theoretical treatments are given to the nucleation, melt transition, and filamentation aspects of the problem. Author (GRA)

N72-29751# Army Foreign Science and Technology Center, Charlottesville, Va.
FERROELECTRICS AND ANTIFERROELECTRICS
G. A. Smolenskii 27 Jan. 1972 634 p refs Transl. into ENGLISH from Segnetoelektriki i Antisegnetoelektriki (Leningrad), 1971 p 1-476
(AD-741037; FSTC-HT-23-456-72) Avail: NTIS CSCL 20/12

The book is devoted to a systematic description of physical phenomena in ferroelectrics and antiferroelectrics. Serious attention is given to thermodynamic, dynamic and model theories of ferroelectricity, which are set forth in a form understandable to a wide range of readers. Results of experimental studies and their correspondence to theoretical representations are discussed in detail using several of the most typical ferroelectrics as an example. Considerable space is set aside for the study of ferroelectrics with the aid of new methods: radiospectroscopy, Messbauer effect, scattering of slow neutrons, electrooptics, etc. A review of ferroelectric and antiferroelectric materials is given including ferroelectrics with magnetic orderliness and with a blurred phase transition. Author (GRA)

N72-29752# Cornell Univ., Ithaca, N.Y. Materials Science Center.
THERMAL FLUCTUATION NOISE IN A SUPERCONDUCTING FLUX DETECTOR
Juhani Kurkijarvi and W. W. Webb 1 May 1972 14 p refs Sponsored in part by ARPA
(Contract N00014-67-A-0077-0016; NR Proj. 319-032)
(AD-741673; MSC-1789; TR-8) Avail: NTIS CSCL 20/12

The principal merit of superconducting quantum interference flux detectors is their remarkable sensitivity. Nevertheless, a basis for calculating their thermal fluctuation noise limitations has only recently been given by J. Kurkijarvi. Here the theory is applied to a calculate the intrinsic noise of the popular radio frequency biased super-conducting quantum flux detector. GRA

N72-29753# Litton Systems, Inc., Morris Plains, N.J. Airtron Div.
RESEARCH ON ZIRCON POLARIZERS Quarterly Report, Jan. - Mar. 1972
Robert Uhrin, Roger F. Belt, and Richard C. Puttbach 28 Apr. 1972 26 p
(Contract N00014-70-C-0379; NR Proj. 016-403)
(AD-741690; R11-590-7; QR-7) Avail: NTIS CSCL 20/2

Experiments on the growth of single crystal zircon ($ZrSiO_4$)

were continued with the hydrothermal method. Autoclaves of 1.0-1.5 inch diameter have produced growth rates of 0.009 inch per day on (100) plane seeds with a mixed mineralizer consisting of 5mKF-1mLiF. The growth temperatures bordering on 600 C are the highest attainable in available hydrothermal systems, but temperature capability will be improved with the acquisition of two new high-temperature alloy systems. Small hydrothermal runs have been made to determine a proper mineralizer for use at temperatures up to 700 C. The 0.5 inch size zircon crystals obtained in large hydrothermal runs are believed to be the largest zircon crystals ever produced synthetically. Author (GRA)

N72-29754# Rensselaer Polytechnic Inst., Troy, N.Y. Div. of Materials Engineering.
SEMICONDUCTION AND ELECTRON HOPPING IN VITREOUS SYSTEMS MICRO-STRUCTURE AND MAGNETIC PROPERTIES: DIELECTRIC AND MAGNETIC PROPERTICS OF INHOMOGENEOUS B2O3-BaO-Fe2O3 GLASS Annual Report, 1 Jan. 1971 - 1 Jan. 1072
Mann J. Park and Robert K. MacCrone 1 Feb. 1972 45 p refs
(Contract N00014-67-A-0117-0008)
(AD-740136; RPI-404.09-TR-3) Avail: NTIS CSCL 20/12

The real and imaginary parts of the dielectric constant of an inhomogeneous 68B2O3-17BaO-15Fe2O3 (mole %) glass have been measured over the temperature range 300 K to 77 K, together with magnetisation measurements over the same temperature range. The morphology of the precipitate particles produced by heat treating at 618 C has been investigated by small angle X-ray scattering and electron microscopy. Two pronounced dielectric dispersions have been found to be associated with a magnetic phase transformation in the glass. The magnetic phase transformation, apparently associated with the Morin transition of the alpha-Fe2O3 precipitates, results in a displaced magnetisation curve along the magnetisation axis on cooling below T(m) in an applied magnetic field. Author (GRA)

N72-29755# Monsanto Research Corp., St. Louis, Mo.
MAGNETIC BUBBLE MATERIALS, INITIAL CHARACTERIZATION REPORT
Jerry W. Moody, Robert M. Sandfort, and Roger W. Shaw Mar. 1972 58 p refs
(Contract DAAH01-72-C-0490; ARPA Order 1999)
(AD-741390) Avail: NTIS CSCL 09/2

The report discusses methods used for the characterization of magnetic bubble materials in the initial phase of the contract. These materials are magnetic garnet films epitaxially deposited on non-magnetic garnet substrates. Properties included in the garnet characterization and in this report are the following: for substrates - defect identification; for substrates and films - composition and lattice parameters; for films only - thickness and thickness variation, defect detection and location, characteristic length and domain dimensions, saturation magnetization and magnetic field, anisotropy field, coercivity, domain wall mobility, and neel temperature. Emphasis is on experimental detail with theory covered by appropriate references where possible. Author (GRA)

N72-29756# Maryland Univ., College Park. Dept. of Electrical Engineering.
THE STUDY OF THE INTERACTION OF INTENSE PICOSECOND LIGHT PULSE WITH MATERIALS: OBSERVATION OF TWO PHOTON CONDUCTIVITY IN GaAs WITH NANOSECOND AND PICOSECOND LIGHT PULSES Quarterly Technical Report, 21 Sep. - 21 Dec. 1971
S. Jayaraman 1 Mar. 1972 18 p refs
(Grant DA-ARO(D)-31-124-71-G55; ARPA Order 675)
(AD-741391; TR-8) Avail: NTIS CSCL 20/12

The effect of photoconductivity in GaAs single crystals was investigated by using both nonosecond and picosecond light pulses for excitation. Both steady state and transient responses of photoconductivity have been observed. Author (GRA)

N72-29757# Illinois Univ., Urbana. Coordinated Science Lab.
STUDY OF DIPOLAR POLARIZATION IN SILICON NITRIDE FILMS USING AN ADAPTED THERMALLY STIMULATED CURRENT TECHNIQUE Ph.D. Thesis
Robert Michael Starnes Apr. 1972 124 p refs
(Contract DAAB07-67-C-0199)
(AD-741243; R-554; UILU-ENG-72-2) Avail: NTIS CSCL 20/12

The thesis is a study of ionic polarization in RF sputtered Si3N4 films by the technique of Thermally Stimulated Current (TSC). The model for this polarization phenomenon is a bound ion which may reside in either of two equilibrium potential minima. When an ion moves from one site to the other it behaves as an electric dipole. The TSC procedure consists of (1) biasing the film to establish a non-equilibrium distribution of ions, (2) thermal quenching to freeze the ions in their non-equilibrium state, and (3) reheating the film while measuring the current resulting from the equilibrium of ions in their states. The thesis describes the construction of an RF sputtering system to deposit refractory insulating films as well as a vacuum dewar and automatic temperature programmer for taking TSC data.
Author (GRA)

N72-29758# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRUE STRUCTURE OF MOLYBDENUM AND TUNGSTEN SINGLE CRYSTALS GROWN FROM THE GAS PHASE
W. Reitzenstein and G. Weise 17 Feb. 1972 22 p refs Transl. into ENGLISH from J. Cryst. Growth (Amsterdam), v. 9, no. 1, 1971 p 228-237
(AF Proj. 7343)
(AD-742416; FTD-HC-23-1787-71) Avail: NTIS CSCL 20/2

It is shown that the morphology, and crystal perfection of single crystals of molybdenum and tungsten obtained by vapor deposition using the thermal decomposition of halides, depends on the supersaturation. The crystals were examined by metallographic investigations and X-rays to determine position, extension, and kind of the disturbances. At lower supersaturations with a given equilibrium form face, disturbances appear regularly in layers and within defined crystallographic positions, which depend on the growth direction in different planes.
Author (GRA)

N72-29759# Wyoming Univ., Laramie. Dept. of Physics.
SPECTRAL THEORY FOR ELECTRON STATES DOPED SEMICONDUCTORS Progress Report, Sep. 1971 - Apr. 1972
Shinzo Nakai 25 Apr. 1972 21 p refs Presented at the Am. Phys. Soc. Meeting, Mar. 1972
(Contract N00014-67-a-0266; NR Proj. 017-652)
(AD-740865) Avail: NTIS CSCL 20/12

Energy spectrum of electron states in doped semiconductors is investigated by using spectral theory of random matrices.
Author (GRA)

N72-29760# Massachusetts Inst. of Tech., Cambridge.
BAND STRUCTURE AND ELECTRICAL PROPERTIES OF AMORPHOUS SEMICONDUCTORS Semiannual Technical Report, 1 Jul. - 31 Dec. 1971
David Adler 31 Dec. 1971 10 p refs
(Contract DAHC04-70-C-0048; ARPA Order 1562)
(AD-740838; SATR-3) Avail: NTIS CSCL 20/12

Contents: threshold switching in thin-film devices; crystalline and amorphous silicon-tellurium alloys; theoretical studies of amorphous semiconductors; and EPR measurements on amorphous solids. GRA

N72-29761# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
[SOLID STATE DEVICES AND MATERIALS, AND INFORMATION SCIENCES] Semiannual Progress Report, 31 Mar. - 1 Oct. 1971

Z. A. Kaprielian 13 Apr. 1972 175 p refs
(Contract F44620-71-C-0067)
(AD-740880; AFOSR-72-0919TR; SAPR-14) Avail: NTIS CSCL 20/12

Content: Semiconductors; Quantum electronics and lasers; Magnetism; Defect chemistry and solid state electrochemistry; Metals, alloys and low temperature physics; Solid state devices; Plasmas and applied electromagnetics; Control systems; Communications systems; Switching, automata theory, computers. GRA

N72-29762# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center.
CADMIUM TELLURIDE. A BIBLIOGRAPHIC SUPPLEMENT Special Bibliography
Feb. 1972 40 p refs
(Contract DSA900-72-C-1182)
(AD-740209; EPIC-SB-5-Supp) Avail: NTIS CSCL 20/12

Cadmium telluride is of considerable interest as a photosensitive material. This compilation provides over 200 citations and abstracts drawn from the Electronic Properties Information Center storage and retrieval system on the preparation and properties of cadmium telluride. Author (GRA)

N72-29763# Florida Univ., Gainesville. Dept. of Metallurgical and Materials Engineering.
STRUCTURE, PROPERTIES AND RADIATION SENSITIVITY OF ELECTRICALLY BISTABLE MATERIALS Annual Report, 6 Feb. 1971 - 6 Feb. 1972
Derek B. Dove, Larry L. Hench, Robert W. Gould, and Ronald E. Loehman 6 Feb. 1972 55 p refs
(Contract DAHC04-70-C-0024; ARPA Order 1562)
(AD-740379; TR-4; AR-2) Avail: NTIS CSCL 20/12

The second annual report describes work carried out on the structural and electrical characterization of chalcogenide glasses. Electron diffraction radial distribution studies have been completed in the As(2)Te(3-x)Se(x) system and the thermal stability of these glasses in the presence of metallic surface layers has been examined. X-ray measurements on the kinetics of crystallization of bulk GeSe(x) glasses have been continued and diffuse scattering data have been obtained on a number of Ge-Se-As bulk glasses. Glass transition and crystallization temperatures have been observed by differential scanning calorimetry, a technique of high sensitivity. A comparison is made between the a.c. conductivity of glasses measured with planar and sandwich electrode configurations. A simple technique employing the decomposition of molybdenum carbonyl is described for the rapid deposition of thick refractory electrodes of good conductivity. Author (GRA)

N72-29764# London Univ. (England).
CALCULATION OF PHYSICAL PROPERTIES OF CO-OPERATIVE ASSEMBLIES Final Technical Report, Apr. 1971 - Mar. 1972
C. Domb Mar. 1972 224 p refs
(Contract DAJA37-71-C-3346; DA Proj. 2O0-61102-B-11-B)
(AD-741388; ERO-E-1490) Avail: NTIS CSCL 20/12

This seven part report is concerned with a detailed study of the susceptibility of the Ising model. Extensive series data above and below the critical temperature for two- and three-dimensional lattices are derived. This data permits elucidation of the critical behavior of the susceptibility and theoretical accounting for the salient properties of the coefficients in terms of ferromagnetic and antiferromagnetic singularities. Methods are developed for deriving the number of self avoiding rings on a lattice and these are used to obtain new data on high temperature specific heat expansions which lead to a more precise knowledge of the specific heat singularity in three dimensions. Author (GRA)

N72-29765# RAND Corp., Santa Monica, Calif.
GUIDE CURVE THEORY FOR INFINITE FILM SPIN WAVE FREQUENCIES
M. Sparks Nov. 1971 9 p refs
(AD-742386; P4722) Avail: NTIS CSCL 20/5

It is shown explicity that the frequencies of small k, infinite film spin waves follows guide curves, which are simply the dispersion relations for pure magnetostatic modes (exchange constant D = O) with the internal field H sub i replaced by H sub i = Dk squared. A previous result, that the magnetostatic-mode (Dk squared negligible) frequencies are independent of the pinning, apart from splitting at crossovers of the guide curves, is a special case of the general result. Two regions of linearity of omega as a function of the magnitude (k sub f) of the wave vector in the plane of the film exist, but have no practical consequences at present. Author (GRA)

N72-29766# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
GROWTH OF EPITAXIAL GALLIUM ARSENIDE BY THE VAPOR PHASE PROCESS M.S. Thesis
James E. Stangel Mar. 1972 113 p refs
(AD-742428; GE/EE/72-24) Avail: NTIS CSCL 20/2

The vapor phase process was used to grow n-type epitaxial gallium arsenide. The system was an open flow type, using the reagents gallium, arsenic trichloride, and hydrogen. The importance of initiating growth after saturating the gallium source with arsenic was demonstrated. The growth rate was shown to be highly dependent on both substrate temperature and total flow rate. It was shown that a higher arsenic trichloride concentration resulted in a lower net donor concentration within the epitaxial layer. Author (GRA)

N72-29767# Lehigh Univ., Bethlehem, Pa. Dept. of Physics.
THEORY OF ELECTRONIC STATES IN INSULATING CRYSTALS Final Scientific Report, 1 Jun. 1967 - 31 Mar. 1972
W. Beall Fowler 30 Apr. 1972 14 p refs
(Grant AF-AFOSR-1276-67; AF Proj. 9761)
(AD-742177; AFOSR-72-1028TR) Avail: NTIS CSCL 20/12

A summary report reflects the technical status of a project conducted within the Advanced Ocean Engineering Laboratory at the Scripps Institution of Oceanography. The project is concerned with overpressures due to earthquakes, including a study of earthquakes and resultant overpressures as they effect ocean-going vehicles and sub-surface structures. Author (GRA)

N72-29768# Army Foreign Science and Technology Center, Charlottesville, Va.
CRYSTALLIZATION OF THIN FILMS
U. A. Arifov 21 Mar. 1972 51 p refs Transl. into ENGLISH of the publ. "Kristallizatsiya Johkim Plenok" Tashkent, FAN, 1970 p 1-216
(AD-741859; FSTC-HT-23-1134-72) Avail: NTIS CSCL 20/12

The collection considers the state of the research into epitaxial growth processes of semiconductor layers, contains material on electrochemical methods of obtaining fine films, the results of studies in diffusion, the migration and distribution of impurities, and discusses the electrophysical characteristics and structure of the thin films and of radiation effects in them. In connection with the problem of the effect of the films on the structural peculiarities of the substrates, and with the problem of self-alloying, the results of a study of the characteristics of monocrystals used as substrates and having an independent significance are presented. Author (GRA)

N72-29769# Army Materials and Mechanics Research Center, Watertown, Mass.
POLARISCOPIC CHARACTERIZATION OF SAPPHIRE AND SPINEL
James W. McCauley Jan. 1972 20 p refs
(DA Proj. 1T0-61102-B-32-A)
(AD-741810; AMMRC-TR-72-1) Avail: NTIS CSCL 20/2

Research on new materials demands sophisticated concurrent characterization not only to optimize fabrication parameters, but

also to insure future quality control. The use of polarized light in a modified polariscope has been used to characterize transparent ingots of sapphire (Al_2O_3) and spinel ($MgAl_2O_4$). Since sapphire is birefringent, the spatial distribution of grain boundaries is easily monitored and can be related to the processing parameters; several examples of cracked and uncracked sapphire disks are presented. Further, the use of the polariscope is also valuable for the characterization of cubic materials like spinel. Grain boundaries cannot be observed as with sapphire, but the distribution of strain birefringence in the ingots provides useful processing modification data. Author (GRA)

N72-29770# South Carolina Univ., Columbia. Dept. of Physics.
OPTICAL AND MAGNETIC RESONANCE STUDY OF TRANSITION METAL MIXED CRYSTALS Final Report, 1 Jul. 1966 - 30 Jun. 1971
Charles P. Poole, Jr. 1 Feb. 1972 14 p refs
(Grant AF-AFOSR-1801-69; AF Proj. 9763)
(AD-742302; AFOSR-72-0613TR) Avail: NTIS CSCL 20/12

The report briefly describes research carried out on several mixed-crystal systems. Manganese spinels were studied over the entire concentration range of (Mg, Mn) Al_2O_4. The Anderson model for exchange narrowing was solved for spins 1-1, 3/2, 2, 5/2 and the results employed to explain the spinel data. Single crystals of chromia alumina were studied at about 50 and about 75 mole per cent chromia. An optical and ESR study of CU(-2) in turquois was carried out and correlated with crystal field theory calculations. A systematic treatment for the calculation of crystal field potentials was formulated. Mossbauer double resonance with the simultaneous application of optical, NMR, and ESR signals was analyzed. The spin orientation in copper Tutton's salts was calculated for the minimum energy state.
Author (GRA)

N72-29771# California Univ., Santa Cruz.
TYPE 2 SEMICONDUCTORS IN NEAR THERMODYNAMIC CRITICAL FIELDS Final Report
Bruce Rosenblum 1972 33 p refs
(Contract N00014-69-A-0200-7001)
(AD-742457) Avail: NTIS CSCL 20/12

The purpose of the report is to see if the superheated state of type 2 superconductors could exist to fields near the thermodynamic critical field as has been theoretically predicted and to study the microwave surface resistance of this state and related phenomena. Author (GRA)

N72-29521 National Bureau of Standards, Washington, D.C.
OBSERVATIONS ON MECHANICALLY ABRADED ALUMINUM OXIDE CRYSTALS BY TRANSMISSION ELECTRON MICROSCOPY
Bernard J. Hockey *In its* The Sci. of Ceramic Machining and Surface Finishing May 1972 p 333-339 refs (For availability see N72-29492 20-15)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N72-29772*# Martin Marietta Corp., Denver, Colo.
INVESTIGATION OF CHARACTERISTICS OF FEED SYSTEM INSTABILITIES Final Report
R. D. Vaage, L. E. Fidler, and R. A. Zehnle May 1972 231 p refs
(Contract NAS8-26266)
(NASA-CR-123752; MCR-72-107) Avail: NTIS HC $13.75 CSCL 21I

The relationship between the structural and feed system natural frequencies in structure-propulsion system coupled longitudinal oscillations (pogo) is investigated. The feed system frequencies are usually very dependent upon the compressibility (compliance) of cavitation bubbles that exist to some extent in all operating turbopumps. This document includes: a complete review of cavitation mechanisms; development of a turbopump cavitation compliance model; an accumulation and analysis of all available cavitation compliance test data; and a correlation of empirical-analytical results. The analytical model is based on the analysis of flow relative to a set of cascaded blades, having any described shape, and assumes phase changes occur under conditions of isentropic equilibrium. Analytical cavitation compliance predictions for the J-2 LOX, F-1 LOX, H-1 LOX and LR87 oxidizer turbopump inducers do not compare favorably with test data. The model predicts much less cavitation than is derived from the test data. This implies that mechanisms other than blade cavitation contribute significantly to the total amount of turbopump cavitation. Author

N72-29773# Fraunhofer-Gesellschaft zur Forderung der Angewandten Forschung e. V., Berghausen (West (Germany).
LIFETIME OF ROCKET PROPELLANTS, GUN PROPELLANTS, AND EXPLOSIVE CHARGES
[1972] 486 p refs partly in GERMAN; partly in FRENCH; and partly in ENGLISH Proc. of the Ann. Meeting of the Inst. fuer Chemie der Treib- und Explosivstoffe, Karlsruhe, West Ger., 1971
Avail: NTIS HC $26.50

The problems of service life and storage stability of explosives, propellants, and solid propellant rocket engines, has been discussed from many viewpoints. Differential thermal analysis and heat generation tests are proposed to determine aging and activation energies. Indications are given for safe life expectations. The influence of surface properties, ambient temperature, humidity, mechanical loading, and binders on storage stability is discussed. For individual titles, see N72-29774 through N72-29794.

N72-29774 Fraunhofer-Gesellschaft zur Forderung der Angewandten Forschung e. V., Berghausen (West (Germany).
THE LIFETIME PROBLEM OF EXPLOSIVES [DIE LEBENSDAUER VON EXPLOSIVSTOFFEN UND IHRE PROBLEME]
H. Schubert *In its* Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 5-23 ref In GERMAN; ENGLISH summary (For availability see N72-29773 20-27)

Specific life expectation criteria for propellant powders, propellant charges, pyrotechnic charges and explosive charges are proposed. The phenomena of aging are surveyed and related research problems are discussed. Besides environmental influence, the chemical and physical processes of aging are mentioned.
ESRO

N72-29775 Institut fuer Chemisch-Technische Untersuchungen, Bonn (West Germany).
POSSIBILITIES OF USING DIFFERENTIAL SCANNING CALORIMETRY FOR THE STUDY OF EXPLOSIVES [UEBER ANWENDUNGSMOEGLICHKEITEN DER DIFFERENTIAL-SCANNING-CALORIMETRIE BEI DER UNTERSUCHUNG VON EXPLOSIVSTOFFEN]
G. Krien *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. e. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 25-39 refs In GERMAN; ENGLISH summary (For availability see N72-29773 20-27)

The application of differential scanning calorimetry to determine thermal properties of explosives is described. In differential scanning calorimetry (DSC), small quantities of samples are heated at a constant rate and the heat flux required to maintain the prescribed temperature is recorded in mcal/sec. The same problems can be solved with DSC equipment which are handled by DTA studies. In addition enthalpies of melting,

conversion and evaporation can be determined quantitatively. It is shown how DSC curves can be used to determine data which are required to apply the theory of thermal explosion, such heat of decomposition, activation energy, pre-exponential factor, reaction order, and specific heat. ESRO

N72-29776 Los Alamos Scientific Lab., N.Mex.
A COMPARISON OF THERMOCHEMICAL METHODS FOR THE DETERMINATION OF KINETICS CONSTANTS
R. N. Rogers *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. e. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 41-56 refs Sponsored by US AEC (For availability see N72-29773 20-27)

Four different differential scanning calorimetric (DSC) methods are used to determine kinetics constants of the same sample of plasticized and stabilized cellulose nitrate. From the DSC plots activation energies may be determined and they are compared with known results obtained by direct measurements. The accuracy is found to be good within the temperature range of measurement. Thermal data are also used to make a quantitative comparison between two different plastic bonded explosive binder phases. ESRO

N72-29777 Naval Postgraduate School, Monterey, Calif.
THE THERMAL DECOMPOSITION OF BETA HMX
J. E. Sinclair and W. Hoondee *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. e. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 57-71 refs Sponsored by Naval Air Systems Command (For availability see N72-29773 20-27)

Thermal decomposition activation energies of beta HMX have been observed using differential thermal analysis (DTA). Kinetic data obtained from DTA changes in heating rates and at isothermal conditions showed differences in the observed activation energies in the three temperature ranges, 473-506, 506-514, and above 514 K at one atmosphere. Calculations have been made of the rate of reaction as a function of time in each of the temperature regions based upon the best available model and compared with the experimental result. ESRO

N72-29778 National Defense Research Organization TNO, Rijswijk (Netherlands).
THE HEAT GENERATION TEST FOR THE DETERMINATION OF THE SELF IGNITION AND THE BALLISTIC STABILITY OF NITRATE ESTER PROPELLANTS
J. L. C. Vangeel *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. e. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 73-87 refs (For availability see N72-29773 20-27)

Self ignition and ballistic stability of nitrate ester propellants are determined by the heat generation test. In this, the heat generated by the powder is measured at elevated temperatures. The measurement is carried out at several temperature levels to calculate the heat generation at low temperatures. The measured results are used to calculate the so-called safe character of the powder which is characteristic of the hazard of self-ignition during storage. The safe diameter is assessed for a storage period of ten years under the assumption of the storage temperature never exceeding 70 C. The decrease of heat of combustion is also calculated. This is an indication of the ballistic stability. ESRO

N72-29779 National Defense Research Organization TNO, Rijswijk (Netherlands).
MEASUREMENT OF THE EFFECTIVE STABILIZER CONTENT IN PROPELLANTS (MES)
T. vandePutte *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. e. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 89-104 (For availability see N72-29773 20-27)

The stability of propellant powder is checked by monitoring effective stabilizer content. Nitrogen dioxide is liberated via decomposition and oxidation reaction in cellulose nitrate and glycerol trinitrate propellants. The decrease in stabilizer content is proportional to the measure in which the decomposition reaction takes place. A method is proposed to determine the effective stabilizer content in a reactor. The measurement is based on the determination of the temperature rise resulting from the exothermal heat effect of the reaction between NO sub 2 and the stabilizer. ESRO

N72-29780 Institut fuer Chemisch-Technische Untersuchungen, Aschau (West Germany).
STATEMENTS ON THE EXPECTED SAFE LIFE DURATION OF PROPELLANT POWDERS BASED ON THE SHORT-TIME TESTS CUSTOMARY IN THE FEDERAL REPUBLIC OF GERMANY [AUSSAGEN UEBER DIE VORAUSSICHTLICHE SICHERHEITSLEBENSDAUER VON TREIBLADUNGSPULVERN AUFGRUND DER IN DER BUNDESREPUBLIK DEUTSCHLAND UEBLICHEN KURZZEITTESTE]
M. Frey *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. e. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 105-124 refs In GERMAN; ENGLISH summary (For availability see N72-29773 20-27)

The safe life of propellant powders and double base solid propellants is assessed based on storage experiences and former stability tests. Powders, satisfying the criteria of German stability tests in the years 1959 to 1963 were re-examined in 1970. The powders had been stored in an airconditioned vault and under depot conditions. Practically no deterioriation was found with respect to earlier examinations. To assess the safe life of propellant powders under normal storage conditions, preliminary storage at 90 C was carried out during 60% of the autocatalytic decomposition point. Results indicate a safe life of at least ten years. ESRO

N72-29781 Fraunhofer-Gesellschaft zur Forderung der Angewandten Forschung e. V., Berghausen (West (Germany).
PROBLEMS OF DETERMINING THE LIFETIME OF SOLID PROPELLANTS [PROBLEME BEI DER ERMITTLUNG DER LEBENSDAUER VON FESTSTREIBSTOFFEN]
F. Volk *In its* Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 125-147 refs In GERMAN; ENGLISH summary (For availability see N72-29773 20-27)

The storage stability of double base solid propellants is investigated with ambient temperatures from 60 to 90 C and the influence of the surface on the weight loss and start of autocatalytic decomposition is determined. It is found that for longer storage periods of up to 80 days the results strongly depend on the surfaces. For the weight loss investigations it is concluded that the mechanism of thermal decomposition of nitric acid esters is invariable. ESRO

N72-29782 Imperial Metal Industries, Ltd., Kidderminster (England).
FACTORS CONCERNED IN THE LIFE ASSESSMENT OF DOUBLE-BASE PROPELLANT ROCKET MOTORS c28
G. I. Evans and S. Gordon *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. E. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 149-181 (For availability see N72-29773 20-27)

The life assessment of rocket motors utilizing cast double base, including composite modified double base propellants are discussed. Motors utilizing case-bonded and loose grain propellant charges are included. The assessment of life is considered in two main categories: Firstly the safe magazine shelf life of the rocket motor and secondly the safe and correct functioning life of the rocket motor. The effect of the environmental storage conditions on the modes of failure and the relevance of the results of accelerated short time/high temperature trial results to realistic deployment and use of rocket motors is discussed. The basic importance of realistic definition of conditions of real life storage, exposure and case environments is stressed. Author (ESRO)

N72-29783 Army Materiel Systems Analysis Agency, Aberdeen Proving Ground, Md.
LIFE CYCLE RELIABILITY PROGRAMS FOR ROCKET MOTORS OF US ARMY MISSILE SYSTEMS c28
L. DeAngelis and R. Bell *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. E. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 183-203 refs (For availability see N72-29773 20-27)

Life cycle reliability programs are described for rocket motors of U.S. Army Missile Systems based on laboratory analyses of rocket propellant samples, static testing of the propellant motors and statistical evaluation of field firings. These have been effective source of data for studying age related problems of field motors and for generating life cycle reliability data. The data are used for developing methodology to compensate for loss in impetus of field motors by application of correction factors, and to extend rocket motor service life by analysis of laboratory test results and pressure and thrust time traces. Needs are cited for life cycle reliability data for propellant formulations of field motors for estimating or extending their service life by other techniques to decrease reliance on static testing. Laboratory testing data on propellant motor formulations, have been obtained as part of a program to develop failure criteria for predicting motor service life. Author (ESRO)

N72-29784 Centre de Recherches du Bouchet, Vert de Petit (France). Service des Poudres.
STABILITY OF COMPOSITE PROPELLANTS SUBMITTED TO IONIZING RADIATION [STABILITE DES PROPERGOLS COMPOSITES AUX RAYONNEMENTS IONISANTS]
A. Davenas *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. E. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive charges [1972] p 205-217 refs In FRENCH; ENGLISH summary (For availability see N72-29773 20-27)

The change in mechanical properties of several composite propellants under gamma irradiation was studied. The doses applied were far above the values absorbed by a rocket exposed to radiation in space over several years. The propellant binder is the most important factor in radiation tolerance. The following binder materials have been investigated: polyurethane, polybutadiene, silicones, and polyisoprenes. It is concluded that polyurethane binder presents the best stability characteristics with respect to radiation aging. ESRO

N72-29785 Explosives Research and Development Establishment, Waltham Abbey (England).
FACTORS GOVERNING THE STORAGE LIFE OF SOLID PROPELLANT ROCKET MOTORS c28
R. Stenson *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. e. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 219-251 refs (For availability see N72-29773 20-27)

The behavior of composite and double-base propellant rocket motors on storage is reviewed and the problems of safety and deterioration in performance are considered with emphasis on the basic chemical and physical changes involved. Storage at elevated temperatures is shown to be very important and accelerated testing is used to predict the effects of much longer cool storage. Tests necessary to avoid eventual spontaneous inflammation include compatibility of ingredients and materials, temperatures of ignition, estimation of the rate of stabilizer consumption and its relation to the safe chemical life, and measurement of heat evolution to permit calculation of cook-off limitations on charge dimensions for double-base or similar reactive propellants. Changes in motor performance are described, in particular rupture of the charge by gas formation due to chemical decomposition within double-base or exotic propellants and from interactions of propellant ingredients with other motor components such as thermal insulants, inhibitors and adhesives. Changes in burning rate, and rheological problems associated with usage over a wide temperature range are included.
Author (ESRO)

N72-29786 Air Force Rocket Propulsion Lab., Edwards AFB, Calif.
SOLID ROCKET PROPELLANT SHELFLIFE ANALYSIS AND PREDICTION
N. Vanderhyde and W. E. Baumgartner (Lockheed Propulsion Co., Redlands, Calif.) *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. e. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 253-274 refs (For availability see N72-29773 20-27)

General aspects in motor shelflife assessment are discussed and recent work in predicting propellant shelflife by mathematical modeling of the failure process is reviewed. One particular failure process is analyzed, namely failure by void or crack formation as a consequence of internal gas generation. A mathematical model is developed for the internal pressure for one-dimensional gas diffusion, and from pressure-time curves derived, a time interval may be predicted wherein failure is to be expected. In addition, the critical pressure is experimentally determined. ESRO

N72-29787 Bayern-Chemie G.m.b.H., Aschau (West Germany).
CONTRIBUTIONS TO THE PROBLEMS OF DETERMINING THE LIFETIME OF COMPOSITE SOLID PROPELLANTS AND RECENT TEST RESULTS [BEITRAG ZU DEN PROBLEMEN DER ERMITTLUNG DER LEBENSDAUER VON COMPOSITE-FESTTREIBSTOFFEN UND NEUERE VERSUCHSERGEBNISSE]
F. Schedlbauer *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. e. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 275-303 refs In GERMAN; ENGLISH summary (For availability see N72-29773 20-27)

In order to determine lifetime, solid composite propellants are stored for periods of up to 12 months at temperatures from -30 to +80 C. The propellants are based on carboxy terminated polybutadiene/ammonium perchlorate. The samples, which differ especially in the composition and quantity of binder, are studied after fixed intervals with respect to their mechanical properties, dimensional changes, rate of combustion, etc. For comparison, solid propellants of the polyurethane/ammonium perchlorate composition were investigated under the same conditions and by the same methods. ESRO

N72-29788 Fraunhofer-Gesellschaft zur Forderung der Angewandten Forschung e. V., Berghausen (West Germany).
INFLUENCE OF HUMIDITY AND MECHANICAL INITIAL STRESS ON THE MECHANICAL PROPERTIES OF SOLID PROPELLANTS [EINFLUSS DER FEUCHTIGKEIT UND DER MECHANISCHEN VORBELASTUNG AUF DIE MECHANISCHEN EIGENSCHAFTEN VON FESTTREIBSTOFFEN]
D. Schmitt *In its* Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 305-327 In GERMAN; ENGLISH summary (For availability see N72-29773 20-27)

The influence of humidity, vibrational stress, dynamic and static loads, upon the strength characteristics of a composite, composite double base, and a double base solid propellant is investigated. It is found that the double base propellant is insensitive to climatic influences, but sensitive to mechanical stresses at elevated temperature; the composite propellant is relatively insensitive to stresses, but sensitive to moisture; and the composite double base is equally sensitive to humidity and stress. ESRO

N72-29789 Centre de Recherches du Bouchet, Vert de Petit (France).
THE MECHANICAL STRENGTH OF SOLID PROPELLANTS [LA TENUE MECHANIQUE DES PROPERGOLS SOLIDES]
J. N. LHuillier *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. e. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 329-358 refs In FRENCH; ENGLISH summary (For availability see N72-29773 20-27)

The tensile strength of a case bonded solid propellant charge is determined from various mechanical tests. The tensile strength depends on the stresses to which it is subjected and on

the propellant's mechanical strength. The stresses are determined by photoelastic measurements and from calculations in which linear elastic or viscoelastic behavior is assumed. The uniaxial or multiaxial mechanical properties of the propellant are known from various mechanical tests and its stress-rupture characteristics depend on the sequence of steps in stress analysis or on its fatigue. The strength is determined from numerous intercomparison calculations, and test series or propellant charges. ESRO

N72-29790 Dynamit Nobel A.G., Cologne (West Germany).
STUDIES OF THE INSULATION MATERIALS EFFECT ON DOUBLE BASE PROPELLANTS [UNTERSUCHUNGEN UEBER DIE BEEINFLUSSUNG VON DOPPELBASIGEN TREIBSTOFFEN DURCH ISOLIERMATERIALEN]
H. Berding *In* Fraunhofer-Ges zur Forderung der Angew. Forsch. e. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 359-374 In GERMAN; ENGLISH summary (For availability see N72-29773 20-27)

The compatibility of double base solid propellants with insulation and adhesive materials is studied with the vacuum reactivity test. The compatibility of silicone, polyester, polyurethane, with cast and extruded double base solid propellants was investigated. Silicone and polyester masses showed good compatibility, whereas epoxy resins and polyurethanes in general exhibited bad compatibility under the specific conditions of this test. With masses of polyurethane which had been in contact with solid propellant over a prolonged period of time there was no decrease in stability of the solid propellant. Gas evolution under test conditions was slightly reduced relative to the original values. ESRO

N72-29791 Explosives Research and Development Establishment, Waltham Abbey (England).
THE INTERACTIONS OF CELLULOSE ACETATE AND ETHYL CELLULOSE INHIBITORS WITH DOUBLE-BASE PROPELLANTS
R. Stenson *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. e. V. Lifetime of Rocket Propellants, Gun Propellants, and explosive charges [1972] p 375-399 ref (For availability see N72-29773 20-27)

The interactions of nitroglycerine in double-base propellants with the inhibition materials cellulose acetate and ethyl cellulose are described. The distribution of nitroglycerine within the inhibitor and the effects of time, temperature, nitrocellulose content of the propellant, barrier layers and fillers on rates of absorption are covered. Reference is made to methods of bonding ethyl cellulose to propellant. Finally the investigations are extended to a range of polymers which are possible inhibitors, and also to a number of plasticisers likely to be present. Author (ESRO)

N72-29792 Josef Meissner, Cologne-bayenthal (West Germany).
INFLUENCE OF PLASTIC BONDED CHARGES ON THE LIFETIME OF MILITARY PYROTECHNICAL SYSTEMS [DER EINFLUSS KUNSTSTOFFGEBUNDENER SAETZE AUF DIE LEBENSDAUER VON GERAETEN DER MILITAERISCHEN PYROTECHNIK]
U. Deisenroth *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. e. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 401-422 In GERMAN; ENGLISH summary (For availability see N72-29773 20-27)

It is investigated to what extent conventional pyrotechnical charges allow the production of equipment with a warranty period of five years or whether a change-over to plastic-bonded formulae will be necessary. Surveys are made of the development during storage of systems with conventional and plastic-bonded charges and the cause for failures is investigated both from the chemical and the fabrication sides. In addition, plastic-bonded smoke charges and their influence on the life of smoke ammunition is studied and the use of plastic-bonded tracer charges is discussed. At the same time, it is possible in the discussion about tracer ammunition to outline the general characteristics of plastic-bonded charges, such as burning mechanism, pressure exponent and processing. Author (ESRO)

N72-29793 Messerschmitt-Boelkow-Blohm G.m.b.H., Schrobenhausen (West Germany).
CHANGE OF BEHAVIOR OF POLYESTER EXPLOSIVES [VERHALTENSAENDERUNG VON POLYESTERSPRENGSTOFFEN]
A. Reichel *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. e. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 423-460 refs In GERMAN; ENGLISH summary (For availability see N72-29773 20-27)

The storage stability of polyester resin bonded military explosives is used to demonstrate that plastic bonded explosive charges are very stable under a variety of environmental influences. Since polyester explosive charges of high mechanical strength are sensitive to such mechanical influences as shock, friction, impact, and bombardment, they must be desensitized with wax. It is shown that adequately selected plastics can be used to replace waxes, and have better mechanical and thermal stability. ESRO

N72-29794 Indian Detonators Ltd., Secunderabad.
INFLUENCE OF TROPICAL STORAGE CONDITIONS ON STABILITY AND PERFORMANCE OF HIGH EXPLOSIVES ESPECIALLY SLURRIES
E. G. Mahadevan *In* Fraunhofer-Ges zur Forderung der Angew. Forsch. e V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 461-475 (For availability see N72-29773 20-27)

The various storage conditions usually encountered in tropics with special reference to India, and the behavior of high explosives, in particular slurries during such storage are described. The physical changes affecting the performance and stability of the commercial explosives are pinpointed and methods to detect and quantify the extent of deterioration which has occurred during such storage is described. The statements made are based on actual data collected during the last two years on explosives which were manufactured for commercial use comprising several types of slurry explosives. Author (ESRO)

N72-29795# Institut fuer Chemie der Treibstoffe, Berghausen (West Germany).
DURABILITY DETERMINATION OF SOLID ROCKET PROPELLANTS. PROBLEM FORMULATION AND TEST PLANNING [DIE BESTIMMUNG DER LEBENSDAUER VON RAKETENFESTTREIBSTOFFEN. PROBLEMSTELLUNG UND VERSUCHSPLANUNG]
D. Schmitt, H. Schubert, and F. Volk 31 Dec. 1971 98 p refs In GERMAN
(ICT-T-Mitt-11/71) Avail: NTIS HC $7.00

Factors influencing the durability of solid x rocket propellants are considered. It is shown that double base and composite solid propellant behave differently. Chemical and physical modifications due to loading are discussed. The test program, which includes setting up of a model for aging phenomena, is defined. Test equipment and methods are outlined. The first experiments have shown that for security reasons long term storage must be increased. ESRO

N72-29796# Institut fuer Chemie der Treibstoffe, Berghausen (West Germany).
PHYSICAL FACTORS INFLUENCING THE EMBRITTLEMENT OF SOLID PROPELLANTS AND PROPELLANT POWDERS: DESIGN OF A TEST PLAN [PHYSIKALISCHE EINFLUSSFAKTOREN AUF DAS VERSPROEDUNGSVERHALTEN VON FESTTREIBSTOFFEN UND TREIBLADUNGSPULVERN AUFSTELLUNG EINES VERSUCHSPLANS]
D. Schmitt 31 Dec. 1971 48 p refs In GEORGIAN
(ICT-8/71) Avail: NTIS HC $4.50

A number of tests have been carried out on double base solid propellants and propellant powders to determine the embrittlement temperature influenced by notches and humidity. A universal testing mach has been used for slow test velocities and a fast tensile tester for high test velocities. The embrittlement temperature is compared to the freezing

temperature, and the embrittlement point is defined in a one-axis load test. The factors mainly influencing embrittlement such as notches and humidity are discussed and the magnitude of their effect is estimated. A test plan is developed for taking into account the most important influences. The material necessary and the expenses are calculated. ESRO

N72-29797# Explosives Research and Development Establishment, Waltham Abbey (England).
FACTORS GOVERNING THE STORAGE LIFE OF SOLID PROPELLANT ROCKET MOTORS
R. Stenson Feb. 1972 23 p refs
(ERDE-TN-47; BR-29470) Avail: NTIS HC $3.25

The behavior of composite and double-base propellant rocket motors on storage is reviewed and the problems of safety and deterioration in performance are considered with emphasis on the basic chemical and physical changes involved. Storage at elevated temperatures is shown to be very important and accelerated testing is used to predict the effects of much longer cool storage. Tests necessary to avoid eventual spontaneous inflammation include compatibility of ingredients and materials, temperatures of ignition, estimation of the rate of stabilizer consumption and its relation to the safe chemical life, and measurement of heat evolution to permit calculation of cook-off limitations on charge dimensions for double-base or similar reactive propellants. Changes in motor performance are described, in particular rupture of the charge of gas formation due to chemical decomposition within double-base or exotic propellants and from interactions of propellant ingredients with other motor components such as thermal insulants, inhibitors, and adhesives. Changes in burning rate and rheological problems are included.
Author (ESRO)

N72-29798# Explosives Research and Development Establishment, Waltham Abbey (England).
PARALLEL PLATE PLASTOMETRY OF PLASTIC PROPELLANT. PART 2: DETERMINATION OF PLASTOVISCOSITY AND FLOW CURVE EQUATIONS
Virginia M. Gledhill and W. A. Dukes Jan. 1972 42 p refs
(ERDE-TR-87; BR-29465) Avail: NTIS HC $4.25

The use of the parallel-plate plastometer has been extended to measure the plastoviscosity of a representative plastic propellant over a wide strain-rate range. The experimental technique is to compress a cylindrical specimen but the results can be analyzed in two ways, yielding either zero-strain or finite-strain plastoviscosities respectively. Both plastoviscosities are, within experimental scatter, inversely proportional to the square root of the strain-rate. The plastoviscosity decreases rapidly and exponentially with increasing strain. When the finite-strain measurements are extrapolated to zero strain, there is good agreement with the zero-strain measurements. The flow curve for a given strain, relating strain-rate with stress, is parabolic. The yield stress and shear-hardening coefficient (measured separately) have been taken into account, resulting in a complete flow equation linking stress, strain and strain-rate, corresponding to a family of flow curves. Author (ESRO)

N72-29799# Royal Aircraft Establishment, Farnborough (England). Engineering Physics Dept.
SPONTANEOUS IGNITION OF AVTUR VAPOUR IN VARIOUS OXYGEN-NITROGEN MIXTURES
J. T. Cansdale London Aeron. Res. Council 1972 25 p refs
Supersedes RAE-TR-71012; ARC-32962
(ARC-CP-1209; RAE-TR-71012; ARC-32962) Avail: NTIS HC $3.25; HMSO £45p; PHI $195

The spontaneous ignition of Avtur vapor in closed heated vessels was investigated to determine the maximum oxygen concentration required to limit ignition pressure rises to 6.9 kN/m2. The aim was to establish the maximum safe oxygen concentration to be permitted within the nitrogen filled heating ducts of the BAC Concorde fuel system test facility. Tests were made in a uniformly heated 0.46 m (18 in) diameter sphere, over a temperature range from 260 to 440 C. An oxygen concentration of less than 1% by volume was necessary to limit ignition pressures. The effect of oxygen concentration on ignition delay time was also studied. Secondly, ignition in the presence of a 0.15 m (6 in) diameter hot pipe in a temperature controlled 0.46 m sphere was investigated at sphere temperatures up to 180 C and pipe temperatures up to 440 C. An oxygen concentration of less than 2.5% by volume was found to limit ignition pressures as required at all conditions considered. It was concluded that in the BAC test rig, a 2.5% oxygen concentration would be low enough to prevent any undesirable ignitions.
Author (ESRO)

N72-29800# Naval Postgraduate School, Monterey, Calif.
NONMETALLIZED COMPOSITE PROPELLANT COMBUSTION
D. W. Netzer, J. R. Kennedy, G. M. Biery, II, and W. E. Brown 1 Mar. 1972 112 p refs
(AD-741072; NPS-57NT72031A) Avail: NTIS CSCL 21/9

An experimental investigation of nonmetallized composite propellant combustion in standard and high acceleration environments was made. Pressed ammonium perchlorate (AP) pellets of varying purity, AP/binder sandwich burners, and propellant strands were employed. AP/binder sandwich burners where studied in an optically equipped centrifuge and color schlieren were taken in a conventional combustion bomb. Ascast and dewetted propellants were used to study the effect of preferential interfacial reactions on burning rate acceleration sensitivity. Results are discussed for the effects of acceleration, pressure, AP purity, and propellant composition on the burning rate. Author (GRA)

N72-29801# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.
STUDIES OF SLURRY FUELED PROPULSION SYSTEMS Semiannual Progress Report, 1 Aug. 1971 - 31 Jan. 1972
Cecil F. Warner, H. Lawrence Dyer, W. C. Mayse, and J. L. Ross Feb. 1972 123 p refs
(Contract N00014-67-A-0226-0013)
(AD-740123; TM-72-4; SAPR-4) Avail: NTIS CSCL 21/4

The literature pertinent to the combustion of aluminum particles is reviewed in some detail. The objective of the review was to obtain information that may be employed to model the combustion of clouds of aluminum particles resulting from the spray of aluminum loaded slurry fuels. The results of the experimental investigation of the depth of penetration of liquid sprays in cross flowing subsonic air streams are compared with values calculated by accepted analytical expressions. Decalin, AVJET-A, SAE-50 motor oil and boron slurry fuel were injected through four swirl type nozzles and one circular orifice. Descriptions of four combustor can configurations are presented together with the results of combustion experiments of those cans with boron slurry fuel. Author (GRA)

N72-29802# Georgia Inst. of Tech., Atlanta.
COMPLEX METAL HYDRIDES. HIGH ENERGY FUEL COMPONENTS FOR SOLID PROPELLANT ROCKET MOTORS Annual Report, 1 Mar. 1971 - 29 Feb. 1972
E. C. Ashby 26 Apr. 1972 63 p refs
(Contract N00014-67-A-0519-0005; NR Proj. 093-050)
(AD-742145) Avail: NTIS CSCL 07/2

Work has continued concerning the preparation and structure elucidation of complex metal hydrides of the main group elements. Research papers are contained in the Appendix of the report. Major developments include: A direct synthesis of iminoalanes, (RNA1H)n compounds. These compounds should be excellent candidates as high energy binders. New complex metal hydrides of magnesium, zinc and copper have been prepared. These compounds should be excellent candidates as high energy propellants and burning rate accelerators. The development of a high vacuum DTA0TGA for the study of the decomposition of complex metal hydrides. A solution to the problem of the existence of HMgA1H4 and NaA1H4 with organomagnesium compounds. Author (GRA)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N72-29803*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DIGITAL-COMPUTER NORMAL SHOCK POSITION AND RESTART CONTROL OF A MACH 2.5 AXISYMMETRIC MIXED-COMPRESSION INLET
George H. Neiner, Gary L. Cole, and Dale J. Arpasi Washington Aug. 1972 50 p refs
(NASA-TN-D-6880; E-6498) Avail: NTIS HC $3.00 CSCL 21E

Digital computer control of a mixed-compression inlet is discussed. The inlet was terminated with a choked orifice at the compressor face station to dynamically simulate a turbojet engine. Inlet diffuser exit airflow disturbances were used. A digital version of a previously tested analog control system was used for both normal shock and restart control. Digital computer algorithms were derived using z-transform and finite difference methods. Using a sample rate of 1000 samples per second, the digital normal shock and restart controls essentially duplicated the inlet analog computer control results. At a sample rate of 100 samples per second, the control system performed adequately but was less stable. Author

N72-29804*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEVELOPMENT AND TESTING OF THE PROPULSION SUBSYSTEM FOR THE MARINER MARS 1971 SPACECRAFT
Richard D. Cannova et al 1 Aug. 1972 118 p refs
(Contract NAS7-100)
(NASA-CR-127751; JPL-TM-33-552) Avail: NTIS HC $8.00 CSCL 21H

The design, testing, fabrication, and problems associated with the development of the Mariner 9 propulsion system are described. Also covered are the design and operation of the associated ground support equipment used to test and service the propulsion system. Author

N72-29805*# Scientific Translation Service, Santa Barbara, Calif.
OPTIMIZATION CRITERIA FOR LOW-THRUST ENGINES OF LIMITED POWER AND A METHOD FOR THEIR IDENTIFICATION
B. N. Petrov et al Washington NASA Aug. 1972 20 p refs Transl. into ENGLISH from the publ. "Upravleniye kosmicheskimi apparatami i korablyami" Moscow, Nauka, 1971 p 377-390 Presented at 2nd Intern. Symp. of IFAC for Automatic Control in the Peaceful Use of Outer Space, Vienna, Sep. 1967 p 377-390
(Contract NASw-2035)
(NASA-TT-F-14384) Avail: NTIS $3.00 CSCL 21H

The problems of minimizing the time and fuel weight of a low-thrust spacecraft with prescribed initial and end conditions is considered using the maximum principle. Three optimization criteria for the weight relationship for spacecraft with a limited power engine are investigated: (1) criterion for maximum of useful load with fixed initial weight, and fixed time; (2) criterion of minimization of the time, weight, and load; and (3) criterion of fixed weight and time. The equations for the dynamic optimization of conditionally controllable engines are extended to the case of low-thrust correcting engines, and the parameters of steady controllable engines in the identification problem are discussed in terms of the transmission function. It is concluded that the system of independent control functions is determined by considering the limitations of power. A method is proposed based on the formulation for determining the correlation functions of the input and output signals of the engine. F.O.S.

N72-29806*# General Electric Co., Cincinnati, Ohio.
HIGHLY LOADED MULTI-STAGE FAN DRIVE TURBINE-TANDEM BLADE CONFIGURATION DESIGN
D. C. Evans and G. W. Wolfmeyer Washington NASA Aug. 1972 67 p refs
(Contract NAS3-14304)
(NASA-CR-2097) Avail: NTIS HC $3.00 CSCL 21E

The results of the tandem blade configuration design study are reported. The three stage constant-inside-diameter turbine utilizes tandem blading in the stage two and stage three vanes and in the stage three blades. All other bladerows use plain blades. Blading detailed design is discussed, and design data are summarized. Steady-state stresses and vibratory behavior are discussed, and the results of the mechanical design analysis are presented. Author

N72-29807*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EXPERIMENTAL FINDINGS FROM ZERO-TANK NET POSITIVE SUCTION HEAD OPERATION OF THE J-2 HYDROGEN PUMP
Henry P. Stinson and Raymond J. Strickland Washington Aug. 1972 36 p refs
(NASA-TN-D-6824; M-368) Avail: NTIS HC $3.00 CSCL 13K

The results of a series of liquid hydrogen turbopump tests to demonstrate the feasibility of zero-tank net positive suction head are presented. A J-2 engine hydrogen pump and S-IVB stage fuel feed system were used for this investigation. The pump was operated at flows and speeds equivalent to normal J-2 engine operating conditions and at hydrogen bulk temperatures between 39 and 45 R. These tests show zero-tank not positive suction head to be a realistic operating mode that should be considered for future applications. Author

N72-29808*# General Electric Co., Cincinnati, Ohio. Aircraft Gas Turbine Div.
EXPERIMENTAL QUIET ENGINE PROGRAM AERODYNAMIC PERFORMANCE OF FAN B
R. G. Giffin, D. E. Parker, and L. W. Dunbar Aug. 1972 117 p refs
(Contract NAS3-12430)
(NASA-CR-72993) Avail: NTIS HC $8.00 CSCL 21E

This report presents the aerodynamic component test results of Fan B, one of two high-bypass-ratio, 1160 feet per second (353.6 m/sec) single-stage fans, which was designed and tested as part of the NASA Experimental Quiet Engine Program. The fan was designed to deliver a bypass pressure ratio of 1.50 with an adiabatic efficiency of 87.0% at a total fan flow of 950 lb/sec (430.9 kg/sec). It was tested with and without inlet distortion. A bypass total pressure ratio of 1.52 and an adiabatic efficiency of 86.9% at a total fan flow of 966 lb/sec (438.2 kg/sec) were actually achieved. An operating margin of 19.5% was demonstrated at design speed. Author

N72-29809# Joint Publications Research Service, Arlington, Va.
ENSURING RELIABLE PERFORMANCE OF AIRCRAFT ENGINE PARTS
A. M. Zaytsev 3 Aug. 1972 257 p refs Transl. into ENGLISH of the book "Obespecheniye Nadezhnoy Raboty Detaley Aviatsionnykh Dvigateley" Moscow, Transport Publ. House, 2 Sep. 1971 196 p
(JPRS-56674) Avail: NTIS HC $15.00

Methods for obtaining reliable performance of aircraft engine parts are presented. The causes of flaws and failures in aircraft engine parts are discussed. Methods of evaluating and predicting the service life of engine parts are explained. Author

N72-29810# Delaware Univ., Newark.
USE OF A RADIAL TURBINE IN A THRUST AUGMENTATION SCHEME
Ronald J. Wills, Barry S. Seidel, and Robert B. Cotton (Wedge Co., Inc., Media, Pa.) 27 Jul. 1972 28 p refs Backup document for AIAA Synoptic scheduled for publication in Journal of Aircraft on Dec. 1972
(Contract N00019-69-C-0668)
Avail: NTIS HC $3.50

A thrust augmentation scheme which uses a partial admission radial inflow impulse turbine placed in the exhaust of a jet engine is described. The torque developed by the turbine is used to wrap up, on a capstan, a cable, fixed at some distant point down the runway. The turbine-capstan is mounted on a wheeled platform so that it tends to follow the jet down the runway. A rigid member connects the platform to the turbojet, allegedly exerting an additional thrust. The equations of motion of the system are presented, and experiments on the turbine's characteristics are described. These characteristics are incorporated in the equations of motion, which are then integrated to yield such information as turbojet distance and velocity versus time, both with and without the augmentation device. Author

N72-29811# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
HUNTING ENERGY IN SPACE
H. Alfven Jun. 1972 7 p refs
(TRITA-EPP-72-16) Avail: NTIS HC $3.00

It is shown that a spacecraft can extract energy from space simply by shooting out electrons in one direction and ions in another. The energy can be used, for example, for propulsion of the spacecraft. Author (ESRO)

N72-29812# Army Foreign Science and Technology Center, Charlottesville, Va.
STARTING OF AIRCRAFT GAS TURBINE ENGINES
M. A. Alabin, B. M. Kats, and Yu. A. Litvinov 12 Jan. 1972 232 p refs Transl. into ENGLISH from the monograph "Zapusk Aviatsionnykh Gazoturbinnykh Dvigatelei" Moscow, 1968 227 p
(AD-740291; FSTC-HT-23-766-70) Avail: NTIS CSCL 21/5

Examined in this book is the theory of starting aviation gas turbine engines on the ground and in flight. This discussion goes into considerably greater detail than previously published literature on aviation engines. The design principles and operating features of individual components of the starter system and engine accessories during start up are examined, the methods of calculating the starting characteristics of various types of engines on the ground and in flight are set forth and the physical essence of starting processes is explained. The inxluence of various factors on engine starting reliability is examined in detail. Methods of calculating engine parameters in the authorotation and low rpm regimes and engine starting reliability limits in flight are given, which can be used in the testing and operation of gas turbine engines. Author (GRA)

N72-29813# Boeing Co., Philadelphia, Pa. Vertol Div.
REGENERATIVE ENGINE POWERED AIRCRAFT DESIGN STUDY Final Report
Richard D. Semple Fort Eustis, Va. Army Air mobility R and D Lab. Jan. 1972 217 p refs
(Contract DAAJ02-70-C-0061; DA Proj. 1G1-62203-D-144)
(AD-741379; D210-10245-1A; USAAMRDL-TR-71-53) Avail: NTIS CSCL 21/5

Characteristics of aircraft with integrated regenerative engine propulsion systems and aircraft with nonregenerative turboshaft engines were determined in order to assess the relative advantages and disadvantages of the engines in a utility transport helicopter application. Conceptual designs of aircraft, powered by regenerative engines and nonregenerative engines of approximately 1000 shp, were based on existing and future Army mission requirements for a typical utility transport helicopter. Comparative weight and performance parameters, reliability aspects, maintenance requirements, life-cycle cost and cost effectiveness for various missions, and overall mission effectiveness and system cost were assessed for these aircraft. Author (GRA)

N72-29814# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AIRCRAFT POWERPLANTS. SYSTEMS AND COMPONENTS
N. T. Domotenke, A. S. Kravets, A. I. Pugachev, and T. I. Sivashenko 4 Feb. 1972 467 p refs Transl. into ENGLISH of the publ. "Aviatsionnyye Silovyye Ustanovki. Sistemy i Ustroystva" 1970 p 1-352
(AD-740211; FTD-HC-23-374-71) Avail: NTIS CSCL 21/5

The book deals with general problems of layout and operation of equipment of aircraft power plants. Given are methods for calculation of systems and devices. The assumptions accepted for educational purposes, which hardly effect the accuracy of results, enabled the authors to obtain comparatively simple formulas and graphs for checking the operation of systems and devices and their design. The book represents a text book for students of civil aviation educational institutions. It can be used also by engineering technical personnel of operational and maintenance enterprises of civil aviation, factories of the aircraft industry, as well as students of aviation institutes. Author (GRA)

N72-29815# TRW Systems Group, Redondo Beach, Calif.
COLLOID ADVANCED DEVELOPMENT PROGRAM Interim Final Report No. 1, 25 May 1970 - 1 Dec. 1971
F. A. Jackson, S. Zafran, J. C. Beynon, P. W. Kidd, W. F. Krieve, H. Shelton, and B. F. Farber Edwards AFB, Calif. AFRPL Feb. 1972 295 p refs
(Contract F33615-70-C-1694; AF Proj. 688F)
(AD-740493; AFRPL-TR-72-10) Avail: NTIS CSCL 21/3

The report is a summary of the first 18 months of the colloid advanced development program. The program objective is to flight-qualify and radiation-harden a colloid thruster system that will deliver one millipound of thrust at a specific impulse of 1500 seconds. The system must have a total impulse capability of approximately 27,500 lb-sec with a total weight of less than 45 pounds and an input power of less than 70 watts. The goal of the program during the reporting period was to develop the components considered critical to system operation. Development models of the thruster, feed system, and neutralizer were designed, fabricated and tested. The results of the tests were used to design breadboard models, which were then fabricated and tested. A breadboard model of the power conditioner was also designed and assembled. After all components were individually evaluated, several short duration integrated system tests were performed. These included thermal, dynamic, nuclear survivability, and reliability analyses. Author (GRA)

N72-29816# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE CONTROL SYSTEM OF THE SOVIET TURBOFAN ENGINE D-30
Emil Wegrzyn 16 Feb. 1972 13 p Transl. into ENGLISH from Tech. Lotnicza Astronaut, (Poland), v. 25, no. 10/11, 1970 p 7-10
(AD-742368; FTD-HC-23-1791-71) Avail: NTIS CSCL 21/5

In the article they have described the operation principles of main components of control system of sovietic turbofan engine D-30: the fuel flow control unit NR 30 that retains constant rotational speed of the high pressure compressor in various flight conditions; the centrifugal governor CR IW that limits the low pressure compressor speed and the centrifugal governor CR 2W that controls the bleed valves and the inlet guide vanes of the high pressure compressor. Author (GRA)

N72-29817# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
DETERMINATION OF THE DRAG OF A WIND TUNNEL MODEL ENGINE DUCT BY APPLICATION OF THE MOMENTUM EQUATION M.S. Thesis
James A. Eggers Mar. 1972 136 p refs
(AD-741744; GAM/AE/72-3) Avail: NTIS CSCL 21/5

A wing body model of an advanced manned interceptor was tested for subsonic force and moment data in a five-foot wind tunnel. A removable engine package contained twin internal airflow passages. Following the collection of force data both with and without the engine package, the inlets and exits of the ducts were instrumented with pressure rakes in order to determine the momentum loss and hence the drag on the model due to the internal flow. Author (GRA)

N72-29782 Imperial Metal Industries, Ltd., Kidderminster (England).
FACTORS CONCERNED IN THE LIFE ASSESSMENT OF DOUBLE-BASE PROPELLANT ROCKET MOTORS
G. I. Evans and S. Gordon *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. E. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 149-181 (For availability see N72-29773 20-27)

N72-29783 Army Materiel Systems Analysis Agency, Aberdeen Proving Ground, Md.
LIFE CYCLE RELIABILITY PROGRAMS FOR ROCKET MOTORS OF US ARMY MISSILE SYSTEMS
L. DeAngelis and R. Bell *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. E. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 183-203 refs (For availability see N72-29773 20-27)

N72-29785 Explosives Research and Development Establishment, Waltham Abbey (England).
FACTORS GOVERNING THE STORAGE LIFE OF SOLID PROPELLANT ROCKET MOTORS
R. Stenson *In* Fraunhofer-Ges. zur Forderung der Angew. Forsch. e. V. Lifetime of Rocket Propellants, Gun Propellants, and Explosive Charges [1972] p 219-251 refs (For availability see N72-29773 20-27)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation, and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N72-29818*# California Inst. of Tech., Pasadena.
SOLAR FLARE PARTICLE PROPAGATION: COMPARISON OF A NEW ANALYTIC SOLUTION WITH SPACECRAFT MEASUREMENTS Ph.D. Thesis
John Edward Lupton [1972] 188 p refs
(Contract NAS5-9312; Grant NGR-05-002-160; NGL-05-002-007)
(NASA-CR-122406) Avail: NTIS HC $11.50 CSCL 03B

A new analytic solution has been obtained to the complete Fokker-Planck equation for solar flare particle propagation including the effects of convection, energy-change, corotation, and diffusion. It is assumed that the particles are injected impulsively at a single point in space, and that a boundary exists beyond which the particles are free to escape. Several solar flare particle events have been observed with the Caltech Solar and Galactic Cosmic Ray Experiment aboard OGO-6. Detailed comparisons of the predictions of the new solution with these observations of 1-70 MeV protons show that the model adequately describes both the rise and decay times. The model gives resonable fits to the time-profile of 1-10 MeV protons from classical flare-associated events. It is not necessary to invoke a scatter-free region near the sun in order to reproduce the fast rise times observed for directly-connected events. The new solution also yields a time-evolution for the vector anisotropy which agrees well with previously reported observations. Author

N72-29819# Lockheed Missiles and Space Co., Palo Alto, Calif.
MEASUREMENT OF THE INTENSITY OF SOLAR L ALPHA RADIATION BY NONOPTICAL METHODS ON THE VERTIKAL-1 ROCKET
L. Martini [1972] 5 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 10, no. 2, 1972 p 255-260
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Results of experiments to measure the intensity of solar ultraviolet radiation in the L alpha line, conducted by using photoelectron analyzer and a Lyman-alpha photometer on the Vertikal-I rocket, are described. According to the data of the Lyman-alpha photometer and the photoelectron analyzer, the intensity of solar L alpha radiation turned out to equal 2.63 and 4.40 erg/sq cm sec, respectively. A comparison between these values obtained by using completely different instruments indicates sufficiently good agreement between the data, if measurement error is taken into account. A comparison made between the present results and the results of a number of experiments by both different authors and the authors of the present paper indicates a comparatively slight time variation in the solar L alpha radiation. Author

N72-29072 Joint Publications Research Service, Arlington, Va.
FACTORS AFFECTING THE BIOLOGICAL EFFECTIVENESS OF PROTONS
M. F. Lomanov *In its* Space Biol. and Med., Vol. 6, No. 3, 1972 3 Aug. 1972 p 137-140 refs (For availability see N72-29051 20-24)

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N72-29820 National Center for Atmospheric Research, Boulder, Colo.
NON-LTE MODEL ATMOSPHERES FOR B AND O STARS
Dimitri Mihalas Jun. 1972 119 p Sponsored by NSF
(NCAR-TN/STR-76) Avail: Issuing Activity

Non-LTE model atmospheres for 15,000 K < or equal to T sub eff < or equal to 55,000 K, 3 x 100 < or equal to g < or equal to 3 x 10,000 are tabulated, along with emergent energy distributions and Balmer line profiles. Several refinements were made over earlier non-LTE models, and this extensive homogeneous grid should be of considerable use in performing spectroscopic diagnostics of the observed spectrum of early type stars, as well as in subsequent statistical-equilibrium calculations of ions of astrophysical interest. Author

N72-29821*# New Mexico Univ., Albuquerque. Dept. of Physics and Astronomy.
INFRARED STUDIES OF THE CIRCUMSOLAR AND NIGHT SKY, APRIL 1968 - 30 NOVEMBER 1971 Final Report, 1 Apr. 1968 - 30 Nov. 1971
Alan W. Peterson Feb. 1972 68 p refs
(Grants NGR-32-004-036)
(NASA-CR-127797) Avail: NTIS HC $5.50 CSCL 03A

A program is summarized of infrared studies of the circumsolar and night sky conducted between April, 1968, and

November 30, 1971, at the University of New Mexico. In addition to observations performed at Capillo Peak Observatory in New Mexico, airborne observations from the Ames Research Center's CV990 were performed in 1968, and eclipses in Siberia (1968) and southern Mexico (1970) were observed. Two dual-channel filter photometers covering wavelengths in the 0.8 to 4.8 micron range were constructed for the aircraft and eclipse observations. A single channel differential photometer was constructed for daytime circumsolar observations. Two large-aperture (12 inch and 24 inch) photometers have been constructed for twilight and night sky photometry. Finally, a small spectrograph for eclipse work has been constructed. It has been used for airglow observations also. Other specialized instrumentation include a four-axis mounting for radial scanning with the eclipse photometers and a 14-inch diameter collimator for use with a black body in calibration of the photometers. The observations performed are included. Author

N72-29822*# California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
A STUDY OF WAVES IN THE EARTH'S BOW SHOCK
Robert E. Holzer, Theodore G. Northrop, John V. Olson, and Christopher T. Russell Nov. 1971 31 p refs
(Contract NAS7-100; JPL-950403; Grant NGR-05-007-276)
(NASA-CR-127793; Publ-949) Avail: NTIS HC $3.75 CSCL 03B

The perturbation vectors of waves up and downstream from the region of maximum compression in the bow shock were examined on OGO-5 under particularly steady solar wind conditions. The polarization of the upstream waves was RH, circular and of the downstream waves LH, elliptical in the spacecraft frame. By observing that the polarization of the waves remained unchanged as the shock motion swept the wave structure back and forth across the satellite three times in eight minutes, it was found that the waves were not stationary in the shock frame. A study of the methods of determining the shock normal indicates that the normal estimated from a shock model should be superior to one based upon magnetic coplanarity. The propagation vectors of the waves examined did not coincide with the shock model normal, the average magnetic field, or the plasma flow velocity. However, the major axis of the polarization ellipse of the downstream wave was nearly parallel to the upstream propagation vector. Author

N72-29823*# California Univ., Berkeley. Space Sciences Lab.
INSTRUMENT REPORT: PLANETARY X-RAY EXPERIMENT
K. A. Anderson 28 Jan. 1972 100 p refs
(Grant NGR-05-003-458)
(NASA-CR-127798; SSL-Ser-1) Avail: NTIS HC $7.00 CSCL 03A

Design studies for an X-ray experiment to investigate planetary magnetospheres using solid state detectors, or proportional counters are reported. The detectors, background counting rate, and leakage fluxes are discussed. It is concluded that the best choice of instruments appears to be two separate multiproportional counters for redundancy. F.O.S.

N72-29824*# IIT Research Inst., Chicago, Ill. Astro Sciences.
PHOTOMETRIC STUDIES OF SATURN'S RING AND ECLIPSES OF THE GALILEAN SATELLITES Final Report
William E. Brunk 21 Apr. 1972 75 p refs
(Contract NASw-2257)
(NASA-CR-127459) Avail: NTIS HC $5.75 CSCL 03B

Reliable data defining the photometric function of the Saturn ring system at visual wavelengths are interpreted in terms of a simple scattering model. To facilitate the analysis, new photographic photometry of the ring has been carried out and homogeneous measurements of the mean surface brightness are presented. The ring model adopted is a plane parallel slab of isotropically scattering particles; the single scattering albedo and the perpendicular optical thickness are both arbitrary. Results indicate that primary scattering is inadequate to describe the photometric properties of the ring: multiple scattering predominates for all angles of tilt with respect to the Sun and earth. In addition, the scattering phase function of the individual particles is significantly anisotropic: they scatter preferentially towards the sun. Photoelectric photometry of Ganymede during its eclipse by Jupiter indicate that neither a simple reflecting-layer model nor a semi-infinite homogeneous scattering model provides an adequate physical description of the Jupiter atmosphere. Author

N72-29825*# Matrix Man Systems, Huntsville, Ala.
EXTRAVEHICULAR ACTITIVIES GUIDELINES
N. E. Brown, T. R. Dashner, and B. C. Hayes 31 Mar. 1972 581 p refs
(Contract NAS8-27502)
(NASA-CR-123751) Avail: NTIS HC $31.25 CSCL 22C

A compendium of data concerning manned spaceflight orbital extravehicular activities is presented. State of-the-art developments in EVA support systems and equipment, operational techniques, guidelines and constraints, and EVA equipment characteristics of specific importance to manned EVA missions are described along with human performance characteristics in the orbital EVA environment. Spaceflight biomedical and physiological aspects, as they relate to extravehicular activities, are also discussed. Limited information is given on alternative systems, such as those using automation and teleoperators. The primary purpose of the EVA guidelines is to present the engineer, mission analyst, and designer with data to efficiently aid in providing an initial solution to his EVA design problem, once the requirement for orbital manned EVA has been established. An extensive bibliography is included for those requiring additional detail in specific areas. Author

N72-29826*# New Hampshire Univ., Durham.
ORIENTATION SYSTEM FOR GAMMA RAY ASTRONOMY EXPERIMENTS
A. J. Mammy 4 Feb. 1972 22 p ref
(Grant NGL-30-002-021)
(NASA-CR-127800) Avail: NTIS HC $3.25 CSCL 03A

A new and rugged orientation system for use in gamma and X-ray astronomy has been built and test flown with favorable results. This system utilizes a versatile equatorial mount for pointing detectors with weights of up to 400 lbs. Author

N72-29827*# Pennsylvania State Univ., University Park.
DYNAMICS AND CONTROL OF ESCAPE AND RESCUE FROM A TUMBLING SPACECRAFT Semiannual Progress Report, 1 Dec. 1971 31 May 1972
Marshall H. Kaplan Jun. 1972 76 p refs
(Grant NGR-39-009-210)
(NASA-CR-127808; SAPR-2) Avail: NTIS HC $6.00 CSCL 22A

Papers on the problem of controlling a tumbling spacecraft before crew rescue is affected are presented. Fluid jets are considered; It is concluded that a gas jet results in long tumble times and low utilization efficiencies and a liquid jet appears more attractive because it can be directed. A conceptual design of an unmanned antitumbling module for automatic dock and detumble is formulated, and analyses of its dynamics and control, synthesis of position and attitude control systems, and sequence of operations are given. The minimum time detumble operation is analyzed with respect to (1) to a constraint on the magnitude of the control moment vector and (2) to constraints on the magnitude of each of the three components of the control moment vector. Internal passive and active mechanisms of energy dissipation are also considered. Structural flexibility modelling techniques and detumbling effects of structural flexibility on free-tumbling motion, are reviewed. Mass expulsion, momentum exchange, and moveable mass techniques are described, and methods of analyzing these devices are surveyed. N.E.N.

N72-29828*# Santa Clara Univ., Calif.
PLANETARY GEOLOGY, STELLAR EVOLUTION AND GALACTIC COSMOLOGY Final Technical Report, 1 Jun. 1971 - 31 May 1972
31 May 1972 6 p refs
(Contract NGR-05-017-027)
(NASA-CR-127796) Avail: NTIS HC $3.00 CSCL 03B

Field studies of selected basalt flows in the Snake River Plain, Idaho, were made for comparative lunar and Mars geological investigations. Studies of basalt lava tubes were also initiated in Washington, Oregon, Hawaii, and northern California. The main effort in the stellar evolution research is toward the development of a computer code to calculate hydrodynamic flow coupled with radiative energy transport. Estimates of the rotation effects on a collapsing cloud indicate that the total angular momentum is the critical parameter. The study of Paschen and Balmer alpha lines of positronium atoms in the center of a galaxy is mentioned. N.E.N.

N72-29829*# Essex Corp., Alexandria, Va.
TELEOPERATOR SYSTEM MAN-MACHINE INTERFACE REQUIREMENTS FOR SATELLITE RETRIEVAL AND SATELLITE SERVICING. VOLUME 1: REQUIREMENTS Final Report
Thomas B. Malone Jun. 1972 113 p
(Contract NASw-2220)
(NASA-CR-123754) Avail: NTIS HC $7.75 CSCL 22C

Requirements were determined analytically for the man machine interface for a teleoperator system performing on-orbit satellite retrieval and servicing. Requirements are basically of two types; mission/system requirements, and design requirements or design criteria. Two types of teleoperator systems were considered: a free flying vehicle, and a shuttle attached manipulator. No attempt was made to evaluate the relative effectiveness or efficiency of the two system concepts. The methodology used entailed an application of the Essex Man-Systems analysis technique as well as a complete familiarization with relevant work being performed at government agencies and by private industry. Author

N72-29830*# Essex Corp., Alexandria, Va.
TELEOPERATOR SYSTEM MAN-MACHINE INTERFACE REQUIREMENTS FOR SATELLITE RETRIEVAL AND SATELLITE SERVICING. VOLUME 2: DESIGN CRITERIA Final Report
Thomas B. Malone Jun. 1972 142 p refs
(Contract NASw-2220)
(NASA-CR-123755) Avail: NTIS HC $10.25 CSCL 22C

For abstract, see N72-29829.

N72-29831*# Texas Univ., Austin.
STUDY OF OPTICAL PROPERTIES OF X-RAY SOURCES Final Report
Paul A. VandenBout 30 Jun. 1972 19 p refs
(Grants NGR-44-012-209)
(NASA-CR-127771; Contrib-66) Avail: NTIS HC $3.00 CSCL 03A

A series of optical and X-ray observations of Sco X-1 and Cyg X-2 by UHURU satellite is reported. Results for Sco X-1 show a definite correlation between optical and X-ray intensity and thus indicate a common emitting region with the source being quiet and having no short term fluctuations bigger than 10%. Spectra reveal the presence of a high excitation complex at wavelength 4650 due to N III-C III. Spectra of a faint 15-mag red object NW of the radio position indicate that Cyg X-1 is associated with a bright B supergiant star. The flux from the edges of the Cygnus Loop in the coronal line at wavelength 5303 was measured to be less than five times ten to the minus nine power erg/sq cm/sterad/sec (0.017 R) in a 3-A band centered on the line. This indicates substantial broadening of the line profile by mass motion or that the temperature is somewhat higher than the present estimate from X-ray data. G.G.

N72-29832*# Texas Univ., Austin.
REPORT ON THE LUNAR RANGING AT MCDONALD OBSERVATORY Technical Report, 16 Feb. 1972 - 15 May 1972
E. C. Silverberg and J. R. Wiant May 1972 37 p
(Grant NGR-44-012-165)
(NASA-CR-127788; RM-72-007) Avail: NTIS HC $4.00 CSCL 03A

The laser ranging operation successfully measured more than 150 lunar ranges during the three lunations ending on 13 May 1972. The accuracy of the measurements averaged about plus or minus 15 cm. Author

N72-29833*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PROBABILITY OF SATELLITE COLLISION
James W. McCarter 8 Jun. 1972 65 p ref
(NASA-TM-X-64671) Avail: NTIS HC $5.25 CSCL 22A

A method is presented for computing the probability of a collision between a particular artificial earth satellite and any one of the total population of earth satellites. The collision hazard incurred by the proposed modular Space Station is assessed using the technique presented. The results of a parametric study to determine what type of satellite orbits produce the greatest contribution to the total collision probability are presented. Collision probability for the Space Station is given as a function of Space Station altitude and inclination. Collision probability was also parameterized over miss distance and mission duration. Author

N72-29834*# Scientific Translation Service, Santa Barbara, Calif.
PHYSICAL CHARACTERISTICS OF THE GIANT PLANETS
V. G. Teyfel, ed. Washington NASA Jun. 1972 227 p refs Transl. into ENGLISH of the book "Fizicheskiye kharakteristiki planet-gigantov" Alma Alta, Nauka, 1971
(Contract NASw-2035)
(NASA-TT-F-717) Avail: NTIS HC $3.00 CSCL 03B

Information about the physical properties of the atmospheres and the internal structure of the giant planets (Jupiter, Saturn, Uranus, and Nepture) is presented. This information is based mainly on the data of astrophysical observations and in part on theoretical calculations. All the data are presented in the form of tables and graphs, accompained only by short explanations. An extensive guide to the literature on the giant planets is also presented, including mainly papers published during the last 20 years. Author

N72-29835*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ELEMENTS OF COST COMPARISON FOR PLANETARY MISSIONS WITH ADVANCED PROPULSION
J. W. Stearns 1 Jul. 1972 33 p refs
(Contract NAS7-100)
(NASA-CR-127754; JPL-TM-33-553) Avail: NTIS HC $3.75 CSCL 22A

Cost and performance comparisons are made between chemical propulsion and nuclear electric propulsion for planetary missions at Jupiter and beyond. Nuclear rocket comparisons are made for performance only. Titan, Saturn, and space shuttle launch are evaluated, utilizing advanced propulsion upper stages. Appendixes include a performance analysis of multiple shuttle launches, with assembly in earth orbit, and a discussion of nonrecurring costs. Author

N72-29836*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
OPTICAL DEPTHS IN THE INTERSTELLAR AND INTERGALACTIC MEDIA
Klaus Schocken Jul. 1972 10 p refs
(NASA-TM-X-64683) Avail: NTIS HC $3.00 CSCL 03B

Optical depths of the interstellar and intergalactic media for

supernova remnants, stars, and galaxies are presented in tabular form. Author

N72-29837*# Techtran Corp., Glen Burnie, Md.
DIELECTRIC PERMEABILITY AND DENSITY OF THE SUBSTANCE OF THE SURFACE LAYER OF MARS
N. N. Krupenio and N. Ya. Shapirovskaya Washington NASA Aug. 1972 34 p refs Transl. into ENGLISH of "Dielektricheskaya Pronitsayemost i Plotnost Veshchestva Poverkhn. Sloya Marsa" Rept. Pr-78 Acad. Sci. USSR, Moscow, 1971 40 p
(Contract NASw-2037)
(NASA-TT-F-14369) Avail: NTIS HC $3.75 CSCL 03B

The results of radar measurements of Mars from the Earth, carried out on long wave centimeter and decimeter bands from 1963 to 1969, are presented. Calculations were obtained on a specific effective area of scattering during a normal fall, of the effective dielectric permeability, and of the density of the substance of the surface layer. These parameters are measured both for local regions, as well as on the average for the planet. Results are compared on various wavelengths for dark and light regions. A systematic decrease in the permeability was noted with measurements at 70 cm wavelength, in comparison with data at 12.5 cm. The dielectric permeabilities for Mars, Venus, and the Moon are compared in the range 3.8 to 70 cm. Author

N72-29838*# Scientific Translation Service, Santa Barbara, Calif.
OPTIMUM STRATEGY WHEN CORRECTING THE TRAJECTORY OF SPACECRAFT
V. A. Ryasin Washington NASA Aug. 1972 19 p refs Transl. into ENGLISH from the publ. "Upravleniye kosmicheskimi apparatami i korablyami" Moscow, Nauka, 1971 p 357-367 Presented at 2nd Intern. Symp. of IFAC for Automatic Control in the Peaceful Use of Outer Space, Vienna, Sep. 1967
(Contract NASw-2035)
(NASA-TT-F-14383) Avail: NTIS HC $3.00 CSCL 22C

An optimum strategy is compiled for the pulse correction of a spacecraft moving close to the rated trajectory. The pulse corrections of the deviations in the actual trajectory from the rated trajectory are discussed in terms of selecting the control method that consumes a minimum of fuel. The differential equations for the spacecraft motion in the vicinity of the rated trajectory are used to determine the optimum strategy for one or two corrections. It is concluded that the success probability with this strategy is close to one. F.O.S.

N72-29839*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
APOLLO 15 CONTAMINATION PHOTOGRAPHY
R. J. Naumann 5 Jul. 1972 62 p refs
(NASA-TM-X-64681) Avail: NTIS HC $5.25 CSCL 22C

The problem of optical contamination in the form of particulates in the vicinity of a spacecraft has been a source of concern for any astronomical experiment that must be performed in sunlight. This concern prompted a photographic photometric experiment on Apollo 15 to measure the brightness of the residual contamination cloud as well as the cloud produced by dumping waste water overboard. An upper limit of 10 to the minus 12.3 power B (B designates the brightness of the solar disc) was placed on the residual cloud at a 90 deg sun angle, which is comparable to the zodiacal light. The brightness of the cloud produced by the waste dump was estimated to be 10 to the minus 9.2 power B. It was observed to decrease rapidly to 10 to the -11.6 power B in minutes, then fluctuate in brightness for at least 25 minutes as additional material left the spacecraft. The cloud was observed to consist of individually resolved particle tracks estimated to be particles ranging from millimeters to centimeters in diameter in addition to a background of unresolved particles with an average diameter of 10.5 microns. Most of the tracks proceeded in straight-line paths from the dump nozzle. Several tracks violated this direction, apparently having been scattered by collisions. A few tracks appeared to have definite curvatures, which are believed to be caused by charged particle interactions. Author

N72-29840*# National Aeronautics and Space Administration, Washington, D.C.
THE PLANET SATURN (1970) Space Vehicle Design Criteria (Environment)
Jun. 1972 103 p refs
(NASA-SP-8091) Avail: NTIS HC $3.00 CSCL 03B

The present-day knowledge on Saturn and its environment are described for designers of spacecraft which are to encounter and investigate the planet. The discussion includes physical properties of the planet, gravitational field, magnetic and electric fields, electromagnetic radiation, satellites and meteoroids, the ring system, charged particles, atmospheric composition and structure, and clouds and atmospheric motions. The environmental factors which have pertinence to spacecraft design criteria are also discussed. N.E.N.

N72-29841# Maryland Univ., College Park.
THE KINEMATICS AND DYNAMICS OF M51 Ph.D. Thesis
R. Brent Tully May 1972 196 p refs
(Grant NSF GP-9514)
Avail: NTIS HC $12.00

A photographic Fabry-Perot interferometer was developed which is pressure regulated. Observations of M51 in H alpha were made on the 84-inch telescope at the Kitt Peak National Observatory. It is shown that the galaxy is considerably more face-on than previously supposed. The axisymmetric distribution of mass, angular momentum, and kinetic energy in rotation are well determined for the interior part of the galaxy. The mass is found to be very centrally condensed. A three-component mass model in accord with the observed rotational velocities was used. The innermost component is associated with bright semistellar nucleus. The outer two components are associated with the nuclear lens and the disk of the galaxy. Evidence is presented for the existence of velocity streaming in the sense predicted by the density-wave theory and for the existence of shocks. A density wave rotating with an angular velocity of 90 km/sec/kpc is consistent with a spiral pattern. This high pattern speed predicts the corotation of the pattern with material in the disk at a radius of only 2.4 kpc. Beyond this radius, the spiral structure is associated with the tidal disruption caused by the encounter with NGC 5195. Author

N72-29842*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NOTE ON THE ORIGIN OF JUPITER'S MAGNETIC FIELD
Kunitomo Sakurai Jul. 1972 15 p refs
(NASA-TM-X-65977; X-693-72-253) Avail: NTIS HC $3.00 CSCL 03B

The effect of the coriolis force was examined for stability of rotating hydromagnetic systems. It is shown that the effect of this force is to inhibit the onset of instability which leads to convective motion in these systems. The possibility of the existence of a dynamo process in Jupiter's interior is discussed, taking into account the effect of the coriolis force. Author

N72-29843*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APOLLO 16 GEOCHEMICAL X-RAY FLUORESCENE EXPERIMENT: PRELIMINARY REPORT
I. Adler, J. Trombka, J. Gerard, P. Lowman, R. Schmadebeck, H. Blodget, E. Eller, L. Yin, R Lamothe, G. Osswald et al Jun. 1972 23 p refs
(NASA-TM-X-65976; X-641-72-246) Avail: NTIS HC $3.25 CSCL 03B

The lunar surface was mapped with respect to Mg, Al and Si as Al/Si and Mg/Si ratios along the projected ground tracks swept out by the orbiting Apollo 16 spacecraft. The results confirm the observations made during the Apollo 15 flight and provide data for a number of features not covered before. The data are consistent with the idea that the moon has a widespread differentiated crust (the highlands). The Al/Si and Mg/Si chemical ratios correspond to those for anorthositic

gabbro through gabbroic anorthosites or feldspathic basalts. The X-ray results suggest the occurrence of this premare crust, or material similar to it, at the Descartes landing site. Author

N72-29844*# California Inst. of Tech., Pasadena.
THE THEORETICAL TOOLS OF EXPERIMENTAL GRAVITATION
Clifford M. Will Jun. 1972 194 p refs Presented at Course 56 of Intern. School of Phys. "Enrico Fermi", Varenna, Italy, 17-29 Jul. 1972 Submitted for publication
(Grants NGR-05-002-256; NSF GP-27304; NSF GP-28027)
(NASA-CR-127806) Avail: NTIS HC $11.75 CSCL 03B

Theoretical frameworks for testing relativistic gravity are presented in terms of a system for analyzing theories of gravity invented as alternatives to Einstein. The parametrized post-Newtonian (PPN) formalism, based on the Dicke framework and the Eotvos-Dicke-Braginsky experiment, is discussed in detail. The metric theories of gravity, and their post-Newtonian limits are reviewed, and PPN equations of motion are derived. These equations are used to analyze specific effects and experimental tests in the solar system. F.O.S.

N72-29845*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MAXIMUM RANGE THREE-DIMENSIONAL LIFTING PLANETARY ENTRY
E. D. Dickmanns Washington Aug. 1972 53 p refs Sponsored in part by NAS-NR
(NASA-TR-R-387; M-199) Avail: NTIS HC $3.00 CSCL 22C

Variational equations for maximum range three-dimensional quasisteady glide are given. Nonlinear oscillatory maximum range trajectories obtained with a refined gradient program are approximated by a superposition of quasisteady glide and linearized perturbation equation results. A basic control law is found which is closely followed for maximum cross-range trajectories. The effect of a reradiative heating constraint involving velocity, altitude and angle of attack on a maximum cross-range trajectory for a space shuttle orbiter-type vehicle reentering the earth's atmosphere is investigated numerically.
Author

N72-29846*# National Aeronautics and Space Administration, Washington, D.C.
USEFUL NEW TECHNOLOGY
[1972] 17 p
Avail: NTIS HC $3.00 CSCL 09C

An introduction to the NASA Technology Utilization Program, how it works, and benefits derived from it is presented. Information is also given on how to obtain NASA technology, the publications, regional dissemination centers, and related topics. N.E.N.

N72-29847# Joint Publications Research Service, Arlington, Va.
BALLISTICS OF MISSILES
A. A. Lebedev and N. F. Gerasyuta 4 Aug. 1972 156 p refs Transl. into ENGLISH from Ballistika Raket (Moscow), 1971 p 108-244
(JPRS-56686) Avail: NTIS HC $10.00

The ballistics of missiles, particularly those missiles with a significant free-flight component in the trajectory, are discussed. Particular attention is given to the characteristics of transient flight sectors, and to those parameters of the missile and its trajectory which influence maximum range and accuracy. Author

N72-29848# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE ROAD TO ORBITAL STATIONS
L. A. Lebedev [1972] 44 p Transl. into ENGLISH from Ser. Kosmonav. Astron., USSR, no. 11, 1971
Avail: NTIS HC $4.25; National Translations Center, John Crerar Library, Chicago, Ill. 60616 CSCL 22C

Experience gained during Soviet space flights leading up to orbital space stations is described, along with the value of space stations to science and technology. The stages in rendezvous and docking of a manned spacecraft with an unmanned satellite are delineated, and the importance of these maneuvers for space station operations is stressed. Results of experiments on Soyuz and Salyut flights are discussed, including astronomical, biomedical, spacecraft maneuvering, and IVA experiments. Emphasis is on the group flight with Soyuz 6, Soyuz 7, and Soyuz 8, and on the Soyuz 9 and Salyut flights. The problems potentially solvable by space station operations are divided into four groups associated with the following: study of the earth; study of the solar system, galaxies, and remote areas of the universe; science-technology and production-engineering aspects related to the spacecraft environment; and the station as a link between earth and other areas of the solar system, such as an interplanetary communication link. N.E.N.

N72-29849# Oak Ridge National Lab., Tenn.
PARAMAGNETIC RESONANCE SPECTRA OF Ti(3 PLUS), Fe(3 PLUS), AND Mn(2 PLUS) IN LUNAR PLAGIOCLASES
R. A. Weeks Mar. 1972 18 p refs Presented at Am. Geophysical Soc. Meeting, Washington, D. C., 17 Apr. 1972 Sponsored by AEC
(Conf-720416-1) Avail: NTIS

At least three paramagnetic and one ferromagnetic components were resolved in the electron magnetic resonance spectra of plagioclase fractions of two lunar samples, 14053-47 and 14321-166. Measurements were made at 9 and 35 GHz and at 300 and 130 K. On the bases of temperature dependence and effective g-values one of the paramagnetic components is attributed to Fe(3+) in crystal sites of low symmetries. A second paramagnetic component with effective g = 2.002 and six lines approximately equally spaced with a separation of 80 gauss is due to a transition of Mn(2+). The third paramagnetic component is attributed to Ti(3+) in crystal sites with symmetry lower than axial. Estimates of the concentrations of Fe(3+) and Ti(3+) give 2 x 10 to the 18th power < n/gm < 2 x 10 to the 19th power and Fe(3+)/Fe(3+) + Fe(2+) approximately equal to 0.1. The ferromagnetic resonance is attributed to single-domain iron particles on the basis of comparison with many lunar samples. The spectrum of Fe(3+) in a plagioclase fraction from Stillwater specimen was quite similar in shape, effective g-values, and relative proportions in various crystal sites. The concentration was approximately five times greater than in the lunar plagioclases. Author

N72-29850# Royal Greenwich Observatory, Herstmonceux (England). Time and Latitude Service.
GREENWICH TIME REPORT Quarterly Report, Jul. - Sep. 1971
R. vdRWoolley Sep. 1971 18 p
Avail: NTIS HC $3.00

Results of Greenwich time and latitude observations for the period from July through September 1971 are presented. Radio time signals and standard frequency emissions are also included. ESRO

N72-29851# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
SHOCK-FREE SOLUTIONS OF SOLAR WIND. COMETARY PLASMA FLOWS?
Max Wallis 17 Nov. 1971 32 p refs Submitted for publication Sponsored by UK Sci. Res. Council
(TRITA-EPP-71-33) Avail: NTIS HC $3.75

The quasi-one-dimensional formulation of the MHD equations is used to describe the ionizing flow in the solar wind's passage through a cometary coma. A set of ordinary differential equations analog to those of Biermann et al., describe the flow along the central stream tube. The nature of the critical (magnetosonic) point is examined for spacial variations R to the minus n power in the ionization rates: the point is a node with shock-free solutions only for locally low gradients, or for interactions with strong cooling. Otherwise, for realistic values n approximately

equal to 2, the critical point is a focus and weakly shocked solutions are appropriate. However, in the external field of laboratory simulation experiments, the critical point disappears and the flow is in any case shock-free. Author (ESRO)

N72-29852# GCA Corp., Bedford, Mass. GCA Technology Div.
SECEDE 2 ROCKET PROBE PAYLOADS Final Technical Report, 15 Apr. 1970 - 18 Feb. 1971
Carl A. Accardo and Herman DeWeerd Dec. 1971 56 p
(Contract F30602-70-C-0288; ARPA Order 1057)
(AD-740428; GCA-TR-71-13-G; RADC-TR-72-9) Avail: NTIS CSCL 19/7

A summary of the engineering design and integration of the ARPA Secede II Program rocket probe payloads which were flown in January 1971 in Eglin Air Force Base is presented. Six Terrier Tomahawk sounding rocket vehicles instrumented with a Langmuir probe, an electric field sensor, a plasma resonance instrument, a solar attitude sensor, a magnetic field sensor, and a telemetry system were flown during the program. In three of the flights, proper payload delivery was not achieved due to vehicle and despin malfunctions. One flight traversed the target successfully. Author (GRA)

N72-29853# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MECHANICS OF SPACE FLIGHT. DYNAMICS OF UNCONTROLLED MOTION OF ENTRY BODIES ENTERING THE ATMOSPHERE
G. E. Duzmak 1 Feb. 1972 356 p refs Transl. into ENGLISH of "Dinamika Neupravlyayemogo Dvizheniya Letatelnykh Apparatov pri Vkhode v Atmosferu" Moscow, 1970 p 1-347
(Contract F33657-71-D-0057)
(AD-740181; FTD-HC-23-161-71) Avail: NTIS CSCL 22/3

During recent years, the problem of the descent to the earth and onto other planets of entry bodies located outside the atmosphere has become very timely. The investigation of the unguided motion of an entry body relative to its center of mass is an important aspect of this problem. The investigation of this motion is necessary in order to determine the overload components, the correct interpretation of the reading of the instruments mounted onboard the entry body, the determination of the disposition of the heat-protective covering, and also for the determination of the dispersion of the landing points.
Author (GRA)

N72-29854# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A COMPARISON OF THE EXTENDED KALMAN FILTER AND WEIGHTED LEAST SQUARES IN EARLY ORBIT DETERMINATION M.S. Thesis
Jackson R. Ferguson, Jr. Dec. 1971 76 p refs
(AD-741457; GA/EE/72S1) Avail: NTIS CSCL 22/3

The problem of estimating the orbit parameters from early-orbit observations of an earth satellite is used to compare the accuracy and application of the extended Kalman filter and the classifical filtering method of weighted least squares. To obtain an absolute comparison, a true two-body, drag-free Keplerian orbit is simulated, observations are computed and contaminated with noise, and the orbit parameters estimated by each filter are compared. The accuracy of the two filters was compared using the same set of observations to determine the effect of observation truncation and initial conditions on the results. Based on this study it was concluded that the weighted least squares filter and the extended Kalman filter yield about the same accuracy in the early-orbit determination problem.
Author (GRA)

N72-29855# Picatinny Arsenal, Dover, N.J.
YEAR-ROUND VISIBILITY LIMITS FOR SCHEDULING YAW SONDE FIRINGS
S. L. Gerhard Mar. 1972 47 p refs
(AD-740649; PA-TR-4287) Avail: NTIS CSCL 14/2

To study the rotational motion of projectiles in free flight, yaw sonde devices are mounted in them to record the motion. Since these devices use the sun's rays to obtain a record, it is necessary to fire test rounds only at times when the sun is in a favorable position. Year charts for three sites (NWC, China Lake, California, Yuma Proving Ground, Yuma, Arizona, and NASA, Wallops Island, Virginia) are shown. From such charts, the most favorable firing times may be chosen for each day in any given year. Range azimuth is the most important factor in determining whether the yaw sonde will see the sun. Author (GRA)

N72-29856# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
PURSUIT-EVASION GAMES BETWEEN TWO SPACECRAFT IN NEAR-EARTH ORBIT M.S. Thesis
Richard H. Woodward Mar. 1972 131 p refs
(AD-741454; GA/MC/72-7) Avail: NTIS CSCL 15/7

The report considers the problem of developing the optimum thrust angle programs for two constant mass, constant thrust spacecraft engaged in pursuit and evasion in near-earth orbit. The problem is formulated as a differential game in which the pursuer attempts to minimize the final separation distance while the evader attempts to maximize it. The problem is approached by linearizing the equations of motion about a circular reference orbit at the earth's surface. The validity of the linearized equations is verified by comparing a linearized trajectory to six non-linear trajectories. The fixed-time and free-time two point boundary value problems are solved for the linear case.
Author (GRA)

N72-29857# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space Research.
INFRARED ROCKET ASTRONOMY Annual Report, 10 May - 15 Nov. 1971
Martin O. Harwit 15 Nov. 1971 13 p refs
(Contract F19628-70-C-0128; ARPA Order 1366; AF Proj. 8692)
(AD-740847; AFCRL-71-0588; AR-2) Avail: NTIS CSCL 17/5

The report describes the work completed between 10 May 1971 and 15 November 1971, and is divided into eight sections; performance of telescope system, integration and vibration testing, rocket flight NP 3.39 -- 16 July 1971, performance of the reassembled telescope system, results of 16 July 1971 flight, ground based effort, personnel, and publications. Author (GRA)

N72-29858# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DETERMINATION OF EARTH SATELLITE ORBITS
Michael E. Ash 19 Apr. 1972 268 p refs
(Contract F19628-70-C-0230; AF Proj. 63430F)
(AD-742301; TN-1972-5; ESD-TR-72-85) Avail: NTIS CSCL 22/3

The formulas used in a computer program to fit earth satellite orbits to data are documented. The areas covered are (1) iterative method of determining maximum likelihood parameter estimates; (2) units are coordinate systems; (3) motion of the earth about its center of mass; (4) equations for earth satellite motion and partial derivatives of this motion with respect to parameters; (5) theoretical values and partial derivatives of theoretical values of ground based (radar or radio transponder, look angles, long baseline interferometer) and satellite based (radar, look angles) observables; and (6) numerical techniques such as numerical integration, polynomial interpolation and matrix inversion. Observations of the sun, moon, planets and stars are also discussed. Author (GRA)

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N72-29859*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SPACE STATION USER'S HANDBOOK Space Station Phase B Extension Period Study
Jan. 1972 111 p
(Contract NAS8-25140)
(NASA-CR-123758; MDC-G2580) Avail: NTIS HC $7.75 CSCL 22B

A user's handbook for the modular space station concept is presented. The document is designed to acquaint science personnel with the overall modular space station program, the general nature and capabilities of the station itself, some of the scientific opportunities presented by the station, the general policy governing its operation, and the relationship between the program and participants from the scientific community. Author

N72-29860*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SPACE STATION USER'S HANDBOOK (REVISED)
Feb. 1972 107 p
(Contract NAS8-25140)
(NASA-CR-123753; MDC-G2580-rev) Avail: NTIS HC $7.50 CSCL 22B

A modular space station concept that furnishes facilities which may be used for experimentation and application during earth orbit missions is described in a user's handbook. The subjects discussed are: (1) overall profile and mission activities for five year on-orbit program, (2) electromagnetic energy transmission through earth atmosphere, (3) effects of atmosphere in limiting resolution, and (4) the hydrological cycle as these subjects apply to the space station data acquisition function.
Author

N72-29861*# PRC Systems Sciences Co., Los Angeles, Calif.
USE OF THE SPACE SHUTTLE TO AVOID SPACECRAFT ANOMALIES
3 May 1972 127 p refs
(Contract NASw-2282)
(NASA-CR-127753; PRC-R-1467) Avail: NTIS HC $8.50 CSCL 22B

An existing data base covering 304 spacecraft of the U.S. space program was analyzed to determine the effect on individual spacecraft failures and other anomalies that the space shuttle might have had if it had been operational throughout the period covered by the data. By combining the results of this analysis, information on the prelaunch activities of selected spacecraft programs, and shuttle capabilities data, the potential impact of the space shuttle on future space programs was derived. The shuttle was found to be highly effective in the prevention or correction of spacecraft anomalies, with 887 of 1,230 anomalies analyzed being favorably impacted by full utilization of shuttle capabilities. The shuttle was also determined to have a far-reaching and favorable influence on the design, development, and test phases of future space programs. This is documented in 37 individual statements of impact. Author

N72-29862*# International Business Machines Corp., Huntsville, Ala. Federal Systems Div.
SPACE STATION DATA FLOW
19 Jun. 1972 256 p
(Contract NAS8-26798)
(NASA-CR-123760; IBM-72W-00213) Avail: NTIS HC $15.00 CSCL 22B

The results of the space station data flow study are reported. Conceived is a low cost interactive data dissemination system for space station experiment data that includes facility and personnel requirements and locations, phasing requirements and implementation costs. Each of the experiments identified by the operating schedule is analyzed and the support characteristics identified in order to determine data characteristics. Qualitative and quantitative comparison of candidate concepts resulted in a proposed data system configuration baseline concept that includes a data center which combines the responsibility of reprocessing, archiving, and user services according to the various agencies and their responsibility assignments. The primary source of data is the space station complex which provides through the Tracking Data Relay Satellite System (TDRS) and by space shuttle delivery data from experiments in free flying modules and orbiting shuttles as well as from the experiments in the modular space station itself. G.G.

N72-29863*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO 16: THIRTY DAY FAILURE AND ANOMALY LISTING REPORT
May 1972 82 p
(NASA-TM-X-68561; MSC-07007) Avail: NTIS HC $6.25 CSCL 22B

The significant anomalies that occurred on the Apollo 16 flight are presented. The major areas under which failures and anomalies are identified are: (1) command and service modules, (2) lunar module, (3) government-furnished equipment, lunar surface experiments, and orbital experiments. All times shown are elapsed time from range zero, established as the integral second before lift-off. Diagrams and photographs of equipment are included to clarify written explanations. Author

N72-29864*# Chrysler Corp., New Orleans, La. Space Div.
ASCENT HEAT TRANSFER RATE DISTRIBUTION ON THE NORTH AMERICAN ROCKWELL DELTA WING ORBITER AND THE GENERAL DYNAMICS/CONVAIR BOOSTER AT A MACH NUMBER OF 8 (MATED)
R. K. Matthews (ARO, Inc.), W. R. Martindale (ARO, Inc.), and J.D. Warmbrod (NASA. Marshall Space Flight Center) Jun. 1972 99 p ref
(Contract NAS8-4016)
(NASA-CR-120049; DMS-DR-1264-Vol-1) Avail: NTIS HC $7.00 CSCL 22B

A wind tunnel test program to determine aerodynamic interference heating on the North American Rockwell orbiter mated with the General Dynamics Convair booster is discussed. The tests were conducted at the Arnold Engineering Development Center (AEDC) in Tunnel B of the von Karman Gas Dynamics Facility (VKF). The test period was June 1971. Heat-transfer rates were determined by the phase-change paint technique on 0.013-scale Stycast models using Tempilaq as the surface temperature indicator. The nominal test conditions were: Mach 8, free-stream unit length Reynolds numbers of 1.25 x one million and 2.55 x one million angles of attack of -5, 0, +5 deg. Model details, test conditions, phase-change paint photographs and reduced heat-transfer coefficients are presented. Author

N72-29865*# Chrysler Corp., New Orleans, La. Space Div.
ASCENT HEAT TRANSFER RATE DISTRIBUTION ON THE NORTH AMERICAN ROCKWELL DELTA WING ORBITER AND THE GENERAL DYNAMICS/CONVAIR BOOSTER AT A MACH NUMBER OF 8 (NOT MATED)
R. K. Matthews (ARO, Inc.), W. R. Martindale (ARO, Inc.), and J.D. Warmbrod (NASA. Marshall Space Flight Center) Jun. 1972 142 p ref
(Contract NAS8-4016)
(NASA-CR-120071; DMS-DR-1264-Vol-2) Avail: NTIS HC $9.25 CSCL 22B

For abstract, see N72-29864

N72-29866*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SCAN POINTING CALIBRATION FOR THE MARINER MARS 1971 SPACECRAFT
W. F. Havens, G. I. Jaivin, G. D. Pace, and R. A. Virzi 1 Aug. 1972 43 p refs
(Contract NAS7-100)
(NASA-CR-127757; JPL-TM-33-556) Avail: NTIS HC $4.25 CSCL 22B

The methods used to calibrate the pointing direction of the Mars 71 spacecraft scan platform are described. Accurate calibration was required to meet the pointing accuracy requirements of the scientific instruments mounted on the platform. A detailed ground calibration was combined with an in-flight calibration utilizing narrow angle television pictures of stars. Results of these calibrations are summarized. Author

N72-29867*# Boeing Co., Seattle, Wash. Research and Engineering Div.
A THERMAL SCALE MODELING STUDY FOR APOLLO AND APOLLO APPLICATIONS, VOLUME 1 Final Report
Roger L. Shannon Jun. 1972 302 p
(Contract NAS9-8332)
(NASA-CR-115752; D180-15048-1-Vol-1) Avail: NTIS HC $17.25 CSCL 22B

The program is reported for developing and demonstrating the capabilities of thermal scale modeling as a thermal design and verification tool for Apollo and Apollo Applications Projects. The work performed for thermal scale modeling of STB; cabin atmosphere/spacecraft cabin wall thermal interface; closed loop heat rejection radiator; and docked module/spacecraft thermal interface are discussed along with the test facility requirements for thermal scale model testing of AAP spacecraft. It is concluded that thermal scale modeling can be used as an effective thermal design and verification tool to provide data early in a spacecraft development program. F.O.S.

N72-29868*# Scientific Translation Service, Santa Barbara, Calif.
A SYSTEM FOR EXAMINING AN AUTOMATICALLY CHECKING THE DYNAMIC CHARACTERISTICS OF THE AUTOMATIC STABILIZATION DEVICE OF A BOOSTER AND SPACE VEHICLE
A. T. Goryachenkov Washington NASA Aug. 1972 14 p Transl. into ENGLISH from the publ. "Upravleniye kosmicheskimi apparatami i korablyami yami" Moscow, Nauka, 1971 p 29-36 Presented at 2d Intern. Symp. of IFAC for Automatic Control in the Peaceful Use of Outer Space, Vienna, Sep. 1967
(Contract NASw-2035)
(NASA-TT-F-14381) Avail: NTIS HC $3.00 CSCL 22B

A system is proposed for examining and automatically checking the dynamic characteristics of the automatic stabilization systems of a booster or space vehicle. The theoretical analysis and experimental investigation are presented to demonstrate the effectiveness of the system. Mathematical models of the system are developed. Diagrams and drawings of the system are included. Author

N72-29869*# Scientific Translation Service, Santa Barbara, Calif.
GAS-DYNAMIC BANK CONTROL OF A SPACECRAFT IN THE ATMOSPHERE
R. V. Studnev Washington NASA Aug. 1972 24 p refs Transl. into ENGLISH from the book "Upravleniye Kosmicheskimi Apparatami i Korablyami" Moscow, Nauka Press 1971 p 482-496
(Contract NASw-2035)
(NASA-TT-F-14387) Avail: NTIS HC $3.25 CSCL 22B

The Pontryagin maximum principle is used to solve the problem of optimal spacecraft attitude control in the atmosphere. The influence of aerodynamic forces on the spacecraft stability is considered. Author

N72-29870*# National Aeronautics and Space Administration, Washington, D.C.
EFFECTS OF STRUCTURAL FLEXIBILITY ON ENTRY VEHICLE CONTROL SYSTEMS Space Vehicle Design Criteria (Guidance and Control)
Jun. 1972 68 p refs
(NASA-SP-8098) Avail: NTIS HC $3.00 CSCL 22B

Control system/structure interactions of space vehicles during planetary and earth entry were investigated with principal emphasis on atmospheric entry and aerodynamic deceleration to subsonic speeds Author

N72-29871*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
S-CUBED-A SPACECRAFT AND EXPERIMENT DESCRIPTION
G. W. Longanecker and R. A. Hoffman Jul. 1972 21 p refs Submitted for publication
(NASA-TM-X-65973; X-646-72-240) Avail: NTIS HC $3.25 CSCL 22B

The launch of the Explorer 45 satellite and the instruments installed in the satellite are discussed. The scientific objectives of the first mission, the orbital parameters, and the capabilities of the data system are examined. The satellite is designed to carry out investigations of specific magnetospheric phenomena in the heart of the magnetosphere. The data handling system is programmable from the ground for greater flexibility. Author

N72-29872*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PREDICTIONS OF VEHICLE ENCOUNTERED ELECTRON AND PROTON FLUXES FOR THE UK-4 SPACECRAFT
E. G. Stassinopoulos Mar. 1972 37 p refs
(NASA-TM-X-65969; X-601-72-131) Avail: NTIS HC $4.00 CSCL 22B

Updated radiation data were obtained for the UK-4 satellite by performing orbital flux integrations for protons and electrons along a specified flight path, using current field and environment models. In this process, adjustments were made to the electron data to account for temporal variations. The final results are presented in tabular and graphical form. Author

N72-29873*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IMP-I SPACECRAFT FINAL MAGNETIC TESTS Final Report
Charles A. Harris Feb. 1972 20 p refs
(NASA-TM-X-65972; X-325-72-183) Avail: NTIS HC $3.00 CSCL 22B

The increased IMP-I spacecraft spin axis moment resulting from excessive field exposures during environmental testing substantiated the need for a final pre-launch magnetic deperm and measurement. By performing a dc rotation deperm it was possible to reduce this moment below the previous initial test post deperm magnitude. In addition, the magnetic field disturbance at the flight magnetometer diminished to below 0.1 nanotesla (gamma) in all directions. Author

N72-29874*# National Aeronautics and Space Administration, Washington, D.C.
ORBITING ASTRONOMICAL OBSERVATORY-C (OAO-C): PRESS KIT
Howard G. Allaway 17 Aug. 1972 29 p
(NASA-News-Release-72-156/156A) Avail: NASA Scientific and Technical Information Facility, P. O. Box 33, College Park, Md. 20740 CSCL 22B

Mission planning for the Orbiting Astronomical Observatory-C (OAO-C) is presented. The characteristics of the observatory and its capabilities are described. The following experiments are discussed: (1) Princeton Experiment Package, (2) X-ray experiment, and (3) guest investigator program. Results of the OAO-2 observatory are presented. A tabulation of flight events is included. Author

N72-29875*# Chrysler Corp., New Orleans, La. Space Div.
SPACE SHUTTLE: AERODYNAMIC CHARACTERISTICS OF A DOUBLE DELTA WING SPACE SHUTTLE ORBITER (M EQUALS 0.6 - 5.0)
Roger R. Ellis (Lockheed Missiles and Space Co.) and Mickey Gamble (Lockheed Missiles and Space Co.) Aug. 1972 617 p
(Contract NAS8-4016)
(NASA-CR-120057; DMS-DR-1254) Avail: NTIS HC $35.85 CSCL 22B

This test program was the first wind tunnel investigation of a double delta wing space shuttle orbiter. The 0.004 scale model used for this test was the first model constructed of this configuration and as such lacked certain refinements incorporated in later models, the principal differences being that the wing is located 0.1 inches model scale further forward than later models and that the nose contours are slightly different. Author

N72-29876*# Chrysler Corp., New Orleans, La. Space Div.
STATIC STABILITY AND CONTROL EFFECTIVENESS OF A PARAMETRIC LAUNCH VEHICLE
Roger R. Ellis (Lockheed Missiles and Space Co.) and Mickey Gamble (Lockheed Missiles and Space Co.) Jul. 1972 1048 p ref
(Contract NAS8-4016)
(NASA-CR-120059; DMS-DR-1256) Avail: NTIS HC $54.50 CSCL 22B

An investigation is reported to determine the static aerodynamic characteristics of a space shuttle parametric launch configuration. The orbiter control surfaces were deflected to obtain the control effectiveness for use in launch vehicle control studies. Experimental data were obtained for Mach number from 0.6 to 4.96, angles of attack from minus 10 to plus 10 degrees and angles of sideslip from minus six to six degrees at zero degrees angle of attack. Author

N72-29877*# Chrysler Corp., New Orleans, La. Space Div.
STATIC AERODYNAMIC CHARACTERISTICS OF THE S-IC BOOSTER/GAC H-33 ORBITER LAUNCH VEHICLE CONFIGURATION
J. F. Sims and R. W. Ainsworth Jul. 1972 512 p
(Contract NAS8-4016)
(NASA-CR-120016; DMS-DR-1187) Avail: NTIS HC $27.75 CSCL 22B

This test at the trisonic tunnel was divided into two parts. The first part utilized the H-33 orbiter with drop tanks and cradle mounted on an S-IC booster with 75 square-foot fins oriented 45 deg off the horizontal and vertical reference planes. Runs were initially made to determine the optimum incidence angle to be used for the remainder of the tests. The angle so determined was 0 degrees. Additional testing was performed with drop tanks removed, orbiter vertical tail removed, drop tanks and orbiter wing removed, booster fins removed and booster fins located in the horizontal and vertical reference planes. The second part utilized the H-33 orbiter and cradle only, sting mounted on a strain gage balance. These data were used in conjunction with test number 504 (orbiter alone on balance) to determine cradle effects. Author

N72-29878*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SKYLAB PAYLOAD SHROUD JETTISON TESTS
Charles J. Daye Washington Aug. 1972 40 p ref
(NASA-TN-D-6913; E-6779) Avail: NTIS HC $3.00 CSCL 22B

The separation concept of the skylab payload shroud is presented, and its behavior in three full-scale jettison tests in vacuum is described. The shroud petal arresting mechanism is explained, as well as the primary and secondary data acquisition systems. The first two tests demonstrated the need for some structural design modifications although the separation process was satisfactory in each test. The third test, incorporating these design modifications, was satisfactory in all aspects of shroud performance. Author

N72-29879*# Scientific Translation Service, Santa Barbara, Calif.
THE CONSTRUCTION OF CONTROL SYSTEMS FOR BOOSTER ROCKETS AND SPACECRAFT WHICH PERFORM HIGH SPEED MOTIONS AROUND THE CENTER OF MASS
A. S. Kachanov Washington NASA Aug. 1972 17 p refs Transl. into ENGLISH from the book "Upravleniye Kosmicheskimi Apparatami i Korablyami" Nauka Press, Moscow p 19-28
(Contract NASw-2035)
(NASA-TT-F-14380) Avail: NTIS HC $3.00 CSCL 22B

A method is proposed which makes it possible to create a two channel system for a booster rocket programmed pitch angle turn with increased angular turn rates. The devices and dynamics of the system are described. Block diagrams and circuit drawings are presented to explain the theoretical aspects. Numerical analyses of the system are included. Author

N72-29880# Royal Aircraft Establishment, Farnborough (England).
THE ORBIT OF COSMOS 44, 1964-53A, FROM MARCH 1968 TO NOVEMBER 1970
Doreen M. C. Walker Aug. 1971 18 p refs
(RAE-TR-71161; BR-26779) Avail: NTIS HC $3.00

The orbit of Cosmos 44, 1964-53A was determined over a complete cycle of argument of perigee using the computer program PROP. The orbits were determined at 28 epochs using 2300 observations from over 100 different observing stations, including Hewitt camera observations from Malvern and Edinburgh used together in a single orbit for the first time. For 25 of the 28 orbits the sd in perigee height were between 30 and 200 m, and the sd in inclination between 0.0002 deg and 0.0017 deg corresponding to distances between 25 and 210 m. The values of perigee distance derived from the 28 orbits show that the amplitude of the oscillation in perigee distance (5.65 km) differs considerably from that expected from the harmonic coefficients in current use. The orbits should therefore lead to an improved model of the earth's gravitational field and much better values for the amplitude of the oscillation for satellites with inclinations near 65 deg. Author (ESRO)

N72-29881# European Space Research Organization, Paris (France).
[ESRO SCIENTIFIC SATELLITE PROGRAM]
May 1972 132 p refs Presented at 15th COSPAR Meeting, Madrid, May 1972 Original contains color illustration
Avail: NTIS HC $8.75

A review of ESRO satellites for 1971 is given including satellite experiments. The satellites in orbit or decayed, such as ESRO 2 (IRIS), ESRO 1 (Aurorae and Boreas), HEOS 1, HEOS 2, TD-1, are included as well as those under development such as ESRO 4, COS-B, and GEOS. Results of the 1971 sounding rocket launchings from Esrange, Sardinia, and Woomera (Australia) are reported. ESRO

N72-29882# European Space Operations Center, Darmstadt (West Germany). Satellite Data Acquisitions Dept.
NETWORK/CONTROL CENTRE OPERATIONS SUMMARY OF THE HEOS A2 MISSION (FROM F-30 DAYS TO START OF ROUTINE PHASE)
Apr. 1972 276 p
Avail: NTIS HC $16.00

The operations summary report for the HEOS A2 satellite from F-30 days to start of the routine phase is presented. Details are given of activities carried out by elements of Operations Control Centre and the ESTRACK stations, in support of the HEOS A2 mission. A brief introduction to the HEOS A2 mission is given and plans formulated for ensuring satisfactory mission support are outlined. The F-30 days activities schedule is given and major activities during this period are summarized. Countdown and launch sequences are shown. Early orbit phase operations, including experiment turn-on is described. Information concerning the spacecraft systems operations during early orbit phase is

presented. The original launch date of 10 December 1971, was not achieved due to vehicle problems. The spacecraft was finally launched on 31 January 1972. ESRO

N72-29883# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
STOPWATCH OBSERVATIONS OF SATELLITES, APRIL 1972
R. D. Eberst 19 May 1972 26 p
(ROE-STS-125) Avail: NTIS HC $3.50

Stopwatch observations made at stations connected with the section are listed in launch and time order for each satellite. Various subtotals are given. Author (ESRO)

N72-29884# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
STOPWATCH OBSERVATIONS OF SATELLITES, MAY 1972
R. D. Eberst 19 Jun. 1972 21 p
(ROE-STS-126) Avail: NTIS HC $3.25

Stopwatch observations made at stations connected with the Section are listed in launch and time order for each satellite. Various subtotals are given. Author (ESRO)

N72-29885# Naval Ordnance Lab., White Oak, Md.
EFFECT OF TRAILING APPENDAGES ON A HYPERSONIC CONE
Maigonis V. Krumins and Norman W. Sheetz, Jr. 20 Jan. 1972 34 p
(AD-740316; NOLTR-72-37) Avail: NTIS CSCL 16/3

An investigation of the effect of trailing appendages on the aerodynamic characteristics of a slender cone at very high Mach numbers is described. A 6.3 degree half-angle cone having two types of appendages was flown and the effect of these appendages on the angle of attack, drag, and stability determined. Also, the effect of Reynolds number was measured. This experimental program was conducted in the 1000-foot Hyperballistics Range at the Naval Ordnance Laboratory. GRA

N72-29886# ARO, Inc., Arnold Air Force Station, Tenn.
DAMPING-IN-PITCH AND DRAG CHARACTERISTICS OF THE VIKING CONFIGURATION AT MACH NUMBERS FROM 1.6 THROUGH 3 Final Report, 21 Jun. - 18 Aug. 1971
Bob L. Uselton and Arthur R. Wallace AEDC May 1972 106 p refs
(Contract F40600-72-C-0003)
(AD-741826; ARO-VKF-TR-72-10; AEDC-TR-72-56) Avail: NTIS CSCL 22/3

Wind tunnel tests were conducted to substantiate earlier test results from another AEDC facility and to determine the dynamic stability characteristics of the Viking-Balloon Launched Decelerator Test (BLDT) configuration. The dynamic instabilities at zero angle of attack which were found during the previous tests were verified by the present tests. For angles of attack of 3 to 15 deg at all Mach numbers, the BLDT configuration was dynamically stable, and the damping derivatives were generally independent of the test variables. Free-flight drag coefficients show good agreement with coefficients obtained from tests on a similar configuration with a string-supported model.
Author (GRA)

N72-29887# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
THE DEVELOPMENT OF FLYING QUALITIES FOR LIFTING RE-ENTRY VEHICLES DURING TERMINAL FLIGHT Final Summary Report, Jul. 1970 - Jun. 1971
Dante A. DiFranco Wright-Patterson AFB, Ohio AFFDL Jul. 1971 27 p refs
(Contract F33615-70-C-1755; AF Proj. 680A)
(AD-742246; CAL-BM-2995-F-2; AFFDL-TR-71-93) Avail: NTIS CSCL 22/2

The report summarizes a three-year effort which led to the development of a preliminary specification for the flying qualities of piloted re-entry vehicles during terminal flight. Part of this effort was directed at the preparation of the rationale and backup data upon which the flying qualities requirements are based. The effort included support of the FDL-8 lifting body program at the Air Force Flight Dynamics Laboratory from the standpoint of handling qualities. Some effort was also directed at lifting re-entry dynamics with time dependent coefficients. Recommendations are made on research programs to improve and extend the handling qualities requirements of lifting re-entry vehicles. Author (GRA)

N72-29888# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACTIVE SHIELDING OF SPACECRAFT
K. A. Trukhanov, T. Ya. Ryabova, and D. Kh. Morozov 10 Mar. 1972 280 p refs Transl. into ENGLISH of the publ. "Aktivanaya Zashchita Kosmicheskikh Korable" 1970 p 1-231
(AD-742410; FTD-HC-23-719-71) Avail: NTIS CSCL 22/2

The report is devoted to problems of active shielding of spacecraft, based on the deflection of streams of charged particles (protons, electrons) by magnetic and electric fields. This method holds great promise, and a great deal of attention has been devoted to perfecting it. The problems of active shielding are presented in a systematized form in the monograph, and a large portion of the material is based on studies by the authors.
Author (GRA)

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N72-29889*# Oklahoma Univ., Norman. School of Aerospace, Mechanical and Nuclear Engineering.
IN-PLANE, FLEXURAL, TWISTING AND THICKNESS-SHEAR COEFFICIENTS FOR STIFFNESS AND DAMPING OF A MONOLAYER FILAMENTARY COMPOSITE, PART 1 Final Report
C. W. Bert and S. Chang Mar. 1972 355 p refs
(Grant NGR-37-003-055)
(NASA-CR-112141) Avail: NTIS HC $19.75 CSCL 13M

Elastic and damping analyses resulting in determinations of the various stiffnesses and associated loss tangents for the complete characterization of the elastic and damping behavior of a monofilament composite layer are presented. For the determination of the various stiffnesses, either an elementary mechanics-of-materials formulation or a more rigorous mixed-boundary-value elasticity formulation is used. The solution for the latter formulation is obtained by means of the boundary-point least-square error technique. Kimball-Lovell type damping is assumed for each of the constituent materials. For determining the loss tangents associated with the various stiffnesses, either the viscoelastic correspondence principle or an energy analysis based on the appropriate elastic stress distribution is used. Author

N72-29890*# Oklahoma Univ., Norman. School of Aerospace, Mechanical and Nuclear Engineering.
VIBRATION AND DAMPING OF LAMINATED, COMPOSITE-MATERIAL PLATES INCLUDING THICKNESS-SHEAR EFFECTS Final Report, Part 2
C. W. Bert and C. C. Siu Mar. 1972 259 p refs
(Grant NGR-37-003-055)
(NASA-CR-112140) Avail: NTIS HC $15.00 CSCL 20K

An analytical investigation of sinusoidally forced vibration of laminated, anisotropic plates including bending-stretching

coupling, thickness-shear flexibility, all three types of inertia effects, and material damping is presented. In the analysis the effects of thickness-shear deformation are considered by the use of a shear correction factor K, analogous to that used by Mindlin for homogeneous plates. Two entirely different approaches for calculating the thickness-shear factor for a laminate are presented. Numerical examples indicate that the value of K depends on the layer properties and the stacking sequence of the laminate. Author

N72-29891*# Battelle Memorial Inst., Columbus, Ohio.
DETERMINATION OF DESIGN ALLOWABLE STRENGTH PROPERTIES OF ELEVATED-TEMPERATURE ALLOYS. PART 1: COATED COLUMBIUM ALLOYS
R. J. Favor, D. J. Maykuth, E. S. Bartlett, and H. Mindlin 31 Mar. 1972 197 p refs
(Contract NAS8-26325)
(NASA-CR-123745) Avail: NTIS HC $12.00 CSCL 20L

A program to determine the characteristics of two coated columbium alloy systems for spacecraft structures is discussed. The alloy was evaluated as coated base material, coated butt-welded material, and material thermal/pressure cycled prior to testing up to 30 cycles. Evaluation was by means of tensile tests covering the temperature range to 2400 F. Design allowables were computed and are presented as tables of data. The summary includes a room temperature property table, effect of temperature curves, and typical stress-strain curves. Author

N72-29892*# Denver Research Inst., Colo. Industrial Economics Div.
A CASE STUDY IN TECHNOLOGY UTILIZATION: FRACTURE MECHANICS
May 1972 35 p refs
(Contract NSR-06-004-063)
(NASA-CR-127779) Avail: NTIS HC $3.75 CSCL 20K

This review of NASA contributions to the technology of fracture mechanics illustrates a fundamental role of the Space Agency in a single technical area. While primarily pursuing its goal of minimizing the weight of flight hardware, NASA engineers have generated innovations having broad impact in nonaerospace communities. A review is given of how these specific NASA innovations are communicated to the technical community outside the Space Agency, and current application areas are outlined. Author

N72-29893# Advisory Group for Aerospace Research and Development, Paris (France).
ACOUSTIC FATIGUE DESIGN DATA, PART 1
A. G. R. Thomson (Eng. Sci. Data Unit Ltd.) May 1972 58 p refs
(AGARD-AG-162-Pt-1; AGARDograph-162-Pt-1) Avail: NTIS HC $5.00

The problem of acoustic fatigue life of a structure subjected to jet noise is introduced. A framework of a design procedure applicable especially to skin panels is described. A method of estimating the near field sound pressure levels due to high velocity jet noise is described, including its limitations. Methods are described to predict the first two groups of natural frequencies of flat and singly curved skin-stringer structures with four different end conditions. The parameters considered are: (1) stringer torsional stiffness, (2) aspect ratio of a typical section, and (3) the number of half-waves across the frame pitch. A method of estimating the root mean square in rectangular skin panels subject to random acoustic loading is presented. Author

N72-29894*# TRW Systems Group, Redondo Beach, Calif.
HOLOGRAPHIC MEASUREMENT OF WAVE PROPAGATION IN AXI-SYMMETRIC SHELLS
David A. Evensen, Robert Aprahamian, and Jerold L. Jacoby Washington NASA Jun. 1972 203 p refs
(Contract NAS1-9876)
(NASA-CR-2063; AM-71-8) Avail: NTIS HC $3.00 CSCL 20K

The report deals with the use of pulsed, double-exposure holographic interferometry to record the propagation of transverse waves in thin-walled axi-symmetric shells. The report is subdivided into sections dealing with: (1) wave propagation in circular cylindrical shells, (2) wave propagation past cut-outs and stiffeners, and (3) wave propagation in conical shells. Several interferograms are presented herein which show the waves reflecting from the shell boundaries, from cut-outs, and from stiffening rings. The initial response of the shell was nearly axi-symmetric in all cases, but nonsymmetric modes soon appeared in the radial response. This result suggests that the axi-symmetric response of the shell may be dynamically unstable, and thus may preferentially excite certain circumferential harmonics through parametric excitation. Attempts were made throughout to correlate the experimental data with analysis. For the most part, good agreement between theory and experiment was obtained. Occasional differences were attributed primarily to simplifying assumptions used in the analysis. From the standpoint of engineering applications, it is clear that pulsed laser holography can be used to obtain quantitative engineering data. Areas of dynamic stress concentration, stress concentration factors, local anomalies, etc., can be readily determined by holography. Author

N72-29895*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ADVANCED APPROACHES TO FATIGUE EVALUATION
Washington 1972 675 p refs Proc. of the 6th ICAF Symp., Miami, 13-14 May 1971
(NASA-SP-309) Avail: NTIS HC $9.00 CSCL 20K

The evaluation of fatigue tests is discussed for supersonic aircraft structures. Aspects of the test program dealing with problems associated with aircraft reliability are emphasized. For individual titles, see N72-29896 through N72-29917.

N72-29896* Royal Aircraft Establishment, Farnborough (England).
THE PHILOSOPHY WHICH UNDERLIES THE STRUCTURAL TESTS OF A SUPERSONIC TRANSPORT AIRCRAFT WITH PARTICULAR ATTENTION TO THE THERMAL CYCLE
E. L. Ripley *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 1-91 refs (For availability see N72-29895 20-32)
CSCL 20K

The information presented is based on data obtained from the Concorde. Much of this data also applies to other supersonic transport aircraft. The design and development of the Concorde is a joint effort of the British and French, and the structural test program is shared, as are all the other activities. Vast numbers of small specimens have been tested to determine the behavior of the materials used in the aircraft. Major components of the aircraft structure, totalling almost a complete aircraft, have been made and are being tested to help the constructors in each country in the design and development of the structure. Tests on two complete airframes will give information for the certification of the aircraft. A static test was conducted in France and a fatigue test in the United Kingdom. Fail-safe tests are being made to demonstrate the crack-propagation characteristics of the structure and its residual strength. Aspects of the structural test program are described in some detail, dealing particularly with the problems associated with the thermal cycle. The biggest of these problems is the setting up of the fatigue test on the complete airframe; therefore, this is covered more extensively with a discussion about how the test time can be shortened and with a description of the practical aspects of the test. Author

N72-29897* Saab Aircraft Co., Linkoping (Sweden).
FATIGUE EXPERIENCE FROM TESTS CARRIED OUT WITH FORGED BEAM AND FRAME STRUCTURES IN THE DEVELOPMENT OF THE SAAB AIRCRAFT VIGGEN
S. E. Larsson *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 93-126 refs (For availability see N72-29895 20-32)

CSCL 20K

A part of the lower side of the main wing at the joint of the main spar with the fuselage frame was investigated. This wing beam area was simulated by a test specimen consisting of a spar boom of AZ 74 forging (7075 aluminum alloy modified with 0.3 percent Ag) and a portion of a honeycomb sandwich panel attached to the boom flange with steel bolts. The cross section was reduced to half scale. However, the flange thickness, the panel height, and the bolt size were full scale. Further, left and right portions of the fuselage frame intended to carry over the bending moment of the main wing were tested. Each of these frame halves consisted of a forward and a rear forging (7079 aluminum alloy, overaged) connected by an outer and inner skin (Alclad 7075) creating a box beam. These test specimens were full scale and were constructed principally of ordinary aircraft components. The test load spectrum was common to both types of specimens with regard to percentage levels. It consisted of maneuver and gust loads, touchdown loads, and loads due to ground roughness. A load history of 200 hours of flight with 15,000 load cycles was punched on a tape. The loads were randomized in groups according to the flight-by-flight principle. The highest positive load level was 90 percent of limit load and the largest negative load was -27 percent. A total of 20 load levels were used. Both types of specimens were provided with strain gages and had a nominal stress of about 300 MN/sq m in some local areas. As a result of the tests, steps were taken to reduce the risk of fatigue damage in aircraft. Thus stress levels were lowered, radii were increased, and demands on surface finish were sharpened. Author

N72-29898* Boeing Co., Everett, Wash.

THE BOEING 747 FATIGUE INTEGRITY PROGRAM

Max M. Spencer *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 127-178 refs (For availability see N72-29895 20-32)

CSCL 20K

The fatigue integrity program which was established to insure economic operations and to provide foundation data for inspection and maintenance is discussed. Significant features of the 747 fatigue integrity program are: (1) fatigue analyses which are continually updated to reflect design changes, fatigue test results, and static and flight load survey measurements; (2) material selection and detail design by using initial fatigue analyses, service experience, and testing; and (3) fatigue testing to check detail design quality and to verify the analyses, culminated by the test of a structurally complete airframe. Fatigue stress analyses were performed with the aid of experimental as well as analytical procedures. Extensive application was made of the stress severity factor, developed at Boeing, for evaluating peak stresses in complex joints. A frame of reference was established by families of structural fatigue performance curves (S-N curves) encompassing the range of materials and fatigue qualities anticipated for the 747 airplane design. Author

N72-29899* Douglas Aircraft Co., Inc., Long Beach, Calif.

FATIGUE AND FAIL-SAFE DESIGN FEATURES OF THE DC-10 AIRPLANE

M. Stone *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 179-211 refs (For availability see N72-29895 20-32)

CSCL 20K

The philosophy and methods used in the design of the DC-10 aircraft to assure structural reliability against cracks under repeated service loads are described in detail. The approach consists of three complementary parts: (1) the structure is designed to be fatigue resistant for a crack-free life of 60,000 flight hours; (2) inasmuch as small undetected cracks could develop from other sources, such as material flaws and manufacturing preloads, the structure also is designed to arrest and control cracks within a reasonable service-inspection interval; and (3) a meaningful service-inspection program has been defined on the basis of analysis and test experience from the design development program. This service-inspection program closes the loop to assure the structural integrity of the DC-10 airframe. Selected materials, fasteners, and structural arrangements are used to achieve these design features with minimum structural weight and with economy in manufacturing and maintenance. Extensive analyses and testing were performed to develop and verify the design. The basic design considerations for fatigue-resistant structure are illustrated in terms of material selection, design loads spectra, methods for accurate stress and fatigue damage analysis, and proven concepts for efficient detail design. Author

N72-29900* Royal Aircraft Establishment, Farnborough (England).

THE PRACTICAL IMPLEMENTATION OF FATIGUE REQUIREMENTS TO MILITARY AIRCRAFT AND HELICOPTERS IN THE UNITED KINGDOM

R. D. J. Maxwell *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 213-229 refs (For availability see N72-29895 20-32)

CSCL 20K

The methods adopted in the United Kingdom to ensure the structural integrity of military aeroplanes and helicopters from the fatigue point of view are described. The procedure adopted from the writing of the specification to the monitoring of fatigue life in service are presented along with the requirements to be met and the way in which they are satisfied. Some of the outstanding problems that remain to be solved are indicated. Author

N72-29901* Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

A PROPOSED USAF FATIGUE EVALUATION PROGRAM BASED UPON RECENT SYSTEMS EXPERIENCE

G. P. Haviland and G. F. Purkey *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 231-251 refs (For availability see N72-29895 20-32)

CSCL 20K

The United States Air Force has published a document entitled Aircraft Structural Integrity Program. One phase of the program is concerned with the fatigue life certification of all types of military aircraft. The document describes the criteria, analyses, and tests that are necessary in order to satisfy the USAF fatigue life requirement. Some recent and valid criticism has been directed toward the document, particularly the fatigue-life requirements contained in it. Some changes are proposed based on surveys conducted in the United States and abroad as well as some recent systems' experience. The surveys covered both military and civilian organizations. The fatigue certification case histories of selected military and commercial aircraft are presented. The design development element tests, preproduction design verification tests, and full-scale fatigue tests of each are described. A brief status report on the revisions to the MIL-A-008860 series specifications is included. Author

N72-29902* National Aerospace Lab., Amsterdam (Netherlands).

FATIGUE TESTS WITH RANDOM FLIGHT SIMULATION LOADING

J. Schijive *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 253-273 refs (For availability see N72-29895 20-32)

CSCL 20K

Crack propagation was studied in a full-scale wing structure under different simulated flight conditions. Omission of low-amplitude gust cycles had a small effect on the crack rate. Truncation of the infrequently occurring high-amplitude gust cycles to a lower level had a noticeably accelerating effect on crack growth. The application of fail-safe load (100 percent limit load) effectively stopped subsequent crack growth under resumed flight-simulation loading. In another flight-simulation test series on sheet specimens, the variables studied are the design stress level and the cyclic frequency of the random gust loading. Inflight mean stresses vary from 5.5 to 10.0 kg/sq mm. The effect of the stress level is larger for the 2024 alloy than for the 7075 alloy. Three frequencies were employed: namely, 10 cps, 1

cps, and 0.1 cps. The frequency effect was small. The advantages and limitations of flight-simulation tests are compared with those of alternative test procedures such as constant-amplitude tests, program tests, and random-load tests. Various testing purposes are considered. The variables of flight-simulation tests are listed and their effects are discussed. A proposal is made for performing systematic flight-simulation tests in such a way that the compiled data may be used as a source of reference. Author

N72-29903* Aeronautical Research Labs., Melbourne (Australia).
RELIABILITY ANALYSIS APPLIED TO STRUCTURAL TESTS
Patricia Diamond and A. O. Payne *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 275-332 refs (For availability see N72-29895 20-32)
CSCL 20K

The application of reliability theory to predict, from structural fatigue test data, the risk of failure of a structure under service conditions because its load-carrying capability is progressively reduced by the extension of a fatigue crack, is considered. The procedure is applicable to both safe-life and fail-safe structures and, for a prescribed safety level, it will enable an inspection procedure to be planned or, if inspection is not feasible, it will evaluate the life to replacement. The theory has been further developed to cope with the case of structures with initial cracks, such as can occur in modern high-strength materials which are susceptible to the formation of small flaws during the production process. The method has been applied to a structure of high-strength steel and the results are compared with those obtained by the current life estimation procedures. This has shown that the conventional methods can be unconservative in certain cases, depending on the characteristics of the structure and the design operating conditions. The suitability of the probabilistic approach to the interpretation of the results from full-scale fatigue testing of aircraft structures is discussed and the assumptions involved are examined. Author

N72-29904* United Aircraft Corp., Stratford, Conn.
FATIGUE OF COMPOSITES
Michael J. Salkind *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 333-364 refs (For availability see N72-29895 20-32)
CSCL 20K

The failure mechanisms in the fatigue of composite materials are analyzed in terms of the requirements for designing fatigue-critical composite structures. Fiber reinforced polymers, fiber reinforced metals, fatigue of composite structures, and composite design considerations are discussed. It is concluded that composite materials offer the engineer the opportunity for tailoring stiffness in different directions for designing dynamic components. F.O.S.

N72-29905* Boeing Co., Seattle, Wash.
FATIGUE DESIGN PROCEDURE FOR THE AMERICAN SST PROTOTYPE
Ralph J. Doty *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 365-403 (For availability see N72-29895 20-32)
CSCL 20K

For supersonic airline operations, significantly higher environmental temperature is the primary new factor affecting structural service life. Methods for incorporating the influence of temperature in detailed fatigue analyses are shown along with current test indications. Thermal effects investigated include real-time compared with short-time testing, long-time temperature exposure, and stress-temperature cycle phasing. A method is presented which allows designers and stress analyzers to check fatigue resistance of structural design details. A communicative rating system is presented which defines the relative fatigue quality of the detail so that the analyst can define cyclic-load capability of the design detail by entering constant-life charts for varying detail quality. If necessary then, this system allows the designer to determine ways to improve the fatigue quality for better life or to determine the operating stresses which will provide the required service life. Author

N72-29906* Avions Marcel Dassault, Saint-Cloud (France).
PRACTICAL ASPECTS OF DESIGNING FOR AND EVALUATING STRUCTURAL INTEGRITY
Marcel Peyrony and Daniel Chaumette *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 405-424 (For availability see N72-29895 20-32)
CSCL 20K

The application of procedures for designing and evaluating structural integrity of various construction techniques is discussed. The fatigue performance improvement of the following conditions is described: (1) conical fasteners, (2) hole preparation, (3) interference fit, and (4) interference protection. The application of fatigue tests to determine fail-safe conditions is analyzed. Author

N72-29907* Krupp (Fried.) G.m.b.H., Essen (West Germany).
ON THE CYCLIC STRESS-STRAIN BEHAVIOR AND LOW CYCLE FATIGUE OF AEROSPACE MATERIALS
J. Burbach *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 425-427 refs (For availability see N72-29895 20-32)
CSCL 20K

The elastic-plastic deformation behavior under cyclic stress of a number of different engineering materials was experimentally investigated with the aid of high-precision methods of measuring, some of which had been newly developed. Experiments made with a variety of steels, the titanium alloy Ti-A16-V4, a cobalt (tungsten) alloy, the high-temperature material Nimonic 90 and Dural (A1-Cu) are reported. The theory given in an attempt to explain these experiments is aimed at finding general formulas for the cyclic stress-strain behavior materials. Author

N72-29908* Federal Labs. for Testing Materials and Research, Dubendorf (Switzerland).
A PARAMETRIC APPROACH TO IRREGULAR FATIGUE PREDICTION
T. H. Erismann *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 429-436 refs (For availability see N72-29895 20-32)
CSCL 20K

A parametric approach to irregular fatigue protection is presented. The method proposed consists of two parts: empirical determination of certain characteristics of a material by means of a relatively small number of well-defined standard tests, and arithmetical application of the results obtained to arbitrary loading histories. The following groups of parameters are thus taken into account: (1) the variations of the mean stress, (2) the interaction of these variations and the superposed oscillating stresses, (3) the spectrum of the oscillating-stress amplitudes, and (4) the sequence of the oscillating-stress amplitudes. It is pointed out that only experimental verification can throw sufficient light upon possibilities and limitations of this (or any other) prediction method. Author

N72-29909* Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
FRACTURE CONTROL PROCEDURES FOR AIRCRAFT STRUCTURAL INTEGRITY
Howard A. Wood *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 437-483 refs (For availability see N72-29895 20-32)
CSCL 20K

The application of applied fracture mechanics in the design, analysis, and qualification of aircraft structural systems are reviewed. Recent service experiences are cited. Current trends in high-strength materials application are reviewed with particular emphasis on the manner in which fracture toughness and structural efficiency may affect the material selection process. General fracture control procedures are reviewed in depth with specific reference to the impact of inspectability, structural arrangement, and material on proposed analysis requirements for safe crack growth. The relative impact on allowable design stress is indicated by example. Design criteria, material, and analysis

requirements for implementation of fracture control procedures are reviewed together with limitations in current available data techniques. A summary of items which require further study and attention is presented. Author

N72-29910* Eidgenossisches Flugzeugwerk, Emmen (Switzerland).
THE INFLUENCE OF MODIFICATIONS OF A FATIGUE LOADING HISTORY PROGRAM ON FATIGUE LIFETIME
J. Branger *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 485-539 refs (For availability see N72-29895 20-32)
CSCL 20K

Rectangular specimens of 7075 and 2014 aluminum alloys with two holes (stress concentration factor of 3.24) have been tested under axial fatigue loading on a six-rod test bed with modifications of the loading program, the surface particulars, and the frequency. The length of the precrack stage was investigated by use of a new crack detector. In most cases the two alloys behaved similarly, with similar life to crack start under the same loading. Some overloads lengthened the life. Truncation by omission of the lowest peak loads should be limited to about 20 percent of the ultimate load. Simplifying counting methods gave misleading results. Very thin surface layers of anodizing, protection by vinyl, dry nitrogen atmosphere, as well as stepwise reaming or grinding the surface of the holes, lengthened the life; thick anodized layers shortened the life. Compressing the hole surface by rolling had no influence. Frequencies at about 210 to 240 cpm produced shorter lives than those at 40 cpm. At 5.4 cpm the life was considerably longer. A model to better understand the precrack-stage fatigue mechanism is discussed. Author

N72-29911* Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany).
STATISTICAL ANALYSIS OF MISSION PROFILE PARAMETERS OF CIVIL TRANSPORT AIRPLANES c02
Otto Buxbaum *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 541-563 refs (For availability see N72-29895 20-32)
CSCL 20K

The statistical analysis of flight times as well as airplane gross weights and fuel weights of jet-powered civil transport airplanes has shown that the distributions of their frequency of occurrence per flight can be presented approximately in general form. Before, however, these results may be used during the project stage of an airplane for defining a typical mission profile (the parameters of which are assumed to occur, for example, with a probability of 50 percent), the following points have to be taken into account. Because the individual airplanes were rotated during service, the scatter between the distributions of mission profile parameters for airplanes of the same type, which were flown with similar payload, has proven to be very small. Significant deviations from the generalized distributions may occur if an operator uses one airplane preferably on one or two specific routes. Another reason for larger deviations could be that the maintenance services of the operators of the observed airplanes are not representative of other airlines. Although there are indications that this is unlikely, similar information should be obtained from other operators. Such information would improve the reliability of the data. Author

N72-29912* National Aerospace Lab., Amsterdam (Netherlands).
STATISTICAL LOAD DATA PROCESSING
G. M. vanDijk *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 565-598 refs (For availability see N72-29895 20-32)
CSCL 20K

A recorder system has been installed on two operational fighter aircrafts. Signal values from a c.g.-acceleration transducer and a strain-gage installation at the wing root were sampled and recorded in digital format on the recorder system. To analyse such load-time histories for fatigue evaluation purposes, a number of counting methods are available in which level crossings, peaks, or ranges are counted. Ten different existing counting principles are defined. The load-time histories are analysed to evaluate these counting methods. For some of the described counting methods, the counting results might be affected by arbitrarily chosen parameters such as the magnitude of load ranges that will be neglected and other secondary counting restrictions. Such influences might invalidate the final counting results entirely. The evaluation shows that for the type of load-time histories associated with most counting methods, a sensible value of the parameters involved can be found. Author

N72-29913* British European Airways, London (England).
DETECTION OF STRUCTURAL DETERIORATION AND ASSOCIATED AIRLINE MAINTENANCE PROBLEMS
H. D. Henniker and R. G. Mitchell (BOAC, London, England) *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 599-609 (For availability see N72-29895 20-32)
CSCL 20K

Airline operations involving the detection of structural deterioration and associated maintenance problems are discussed. The standard approach to the maintenance and inspection of aircraft components and systems is described. The frequency of inspections and the application of preventive maintenance practices are examined. The types of failure which airline transport aircraft encounter and the steps taken to prevent catastrophic failure are reported. P.N.F.

N72-29914* National Transportation Safety Board, Washington, D.C.
FATIGUE FAILURE OF METAL COMPONENTS AS A FACTOR IN CIVIL AIRCRAFT ACCIDENTS c02
William L. Holshouser and Ruth D. Mayner *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 611-630 (For availability see N72-29895 20-32)
CSCL 20K

A review of records maintained by the National Transportation Safety Board showed that 16,054 civil aviation accidents occurred in the United States during the 3-year period ending December 31, 1969. Material failure was an important factor in the cause of 942 of these accidents. Fatigue was identified as the mode of the material failures associated with the cause of 155 accidents and in many other accidents the records indicated that fatigue failures might have been involved. There were 27 fatal accidents and 157 fatalities in accidents in which fatigue failures of metal components were definitely identified. Fatigue failures associated with accidents occurred most frequently in landing-gear components, followed in order by powerplant, propeller, and structural components in fixed-wing aircraft and tail-rotor and main-rotor components in rotorcraft. In a study of 230 laboratory reports on failed components associated with the cause of accidents, fatigue was identified as the mode of failure in more than 60 percent of the failed components. The most frequently identified cause of fatigue, as well as most other types of material failures, was improper maintenance (including inadequate inspection). Fabrication defects, design deficiencies, defective material, and abnormal service damage also caused many fatigue failures. Four case histories of major accidents are included in the paper as illustrations of some of the factors involved in fatigue failures of aircraft components. Author

N72-29915* Societe Nationale Industrielle Aerospatiale, Toulouse (France).
FATIGUE TESTS ON BIG STRUCTURE ASSEMBLIES OF CONCORDE AIRCRAFT
V. P. NGuyen and J. P. Perrais (Centre d'Essais Aeron., Toulouse, France) *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 631-648 (For availability see N72-29895 20-32)
CSCL 20K

Fatigue tests on structural assemblies of the Concorde supersonic transport aircraft are reported. Two main sections of the aircraft were subjected to pressure, mechanical load, and

thermal static tests. The types of fatigue tests conducted and the results obtained are discussed. It was concluded that on a supersonic aircraft whose structural weight is a significant part of the weight analysis, many fatigue and static strength development tests should be made and fatigue and thermal tests of the structures are absolutely necessary. Author

N72-29916* British Aircraft Corp., Filton (England).
STRUCTURAL TESTING OF CONCORDE AIRCRAFT: FURTHER REPORT ON UNITED KINGDOM TESTS
Norman Harpur *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluations 1972 p 649-665 (For availability see N72-29895 20-32)
CSCL 20K

A summary of tests conducted on the Concorde aircraft nacelle structure is presented. The tests were conducted as a part of the structural development and certification program. The nacelle structural specimens are described. The problems associated with the intake testing and engine-bay and nozzle testing are discussed. Author

N72-29917* Aeronautical Research Labs., Melbourne (Australia).
A COMPARISON OF RELIABILITY AND CONVENTIONAL ESTIMATION OF SAFE FATIGUE LIFE AND SAFE INSPECTION INTERVALS c15
F. H. Hooke *In* NASA. Langley Res. Center Advanced Approaches to Fatigue Evaluation 1972 p 667-680 refs (For availability see N72-29895 20-32)
CSCL 20K

Both the conventional and reliability analyses for determining safe fatigue life are predicted on a population having a specified (usually log normal) distribution of life to collapse under a fatigue test load. Under a random service load spectrum, random occurrences of load larger than the fatigue test load may confront and cause collapse of structures which are weakened, though not yet to the fatigue test load. These collapses are included in reliability but excluded in conventional analysis. The theory of risk determination by each method is given, and several reasonably typical examples have been worked out, in which it transpires that if one excludes collapse through exceedance of the uncracked strength, the reliability and conventional analyses gave virtually identical probabilities of failure or survival. Author

N72-29918*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VISCEL: A GENERAL PURPOSE COMPUTER PROGRAM FOR ANALYSIS OF LINEAR VISCOELASTIC STRUCTURES, VOLUME 2
K. K. Gupta and F. A. Akyuz 15 Jul. 1972 50 p refs
(Contract NAS7-100)
(NASA-CR-127750; JPL-TM-33-466-Vol-2) Avail: NTIS HC $4.50 CSCL 20K

The VISCEL program is a general purpose computer program developed for equilibrium analysis of linear viscoelastic structures. The program is written in FORTRAN 5 language to operate on the Univac 1108 computer under the EXEC 8 operating system. The program, an extension of the linear equilibrium problem solver ELAS, is an updated and extended version of its earlier form written for the IBM 7094 computer. Finite element matrix displacement approach coupled with the synchronized material property concept, utilizing incremental time steps, was adopted for the solution presented. The step-by-step procedure involves solution of recursive equations in the time domain, which takes into account the memory of material properties. Incremental and accumulative displacements and stresses are obtained at the end of each time step. In order to minimize the extent of computations resulting from accumulative effects of material memory, the program provides an option which enables the employment of constant time steps in the logarithmic scale. Program documentation is presented. Author

N72-29919* National Aeronautics and Space Administration, Washington, D.C.
NASTRAN DEMONSTRATION PROBLEM MANUAL (LEVEL 15)
Jun. 1972 187 p
(NASA-SP-224(01)); Computer Software Management and Information Center, Barrows Hall, University of Georgia, Athens, Georgia 30601 $15.00 CSCL 13M

A manual of problems which are solved by the NASA Structural Analysis (NASTRAN) program are presented. The problems are demonstrated under the following broad headings: (1) rigid formats, (2) execution options, (3) structure definition options, (4) static loading, (5) dynamic modeling, (6) dynamic excitation, (7) output options, (8) option for thermal bending, (9) option for hydroelastic analysis, (10) option for acoustic cavity analysis, (11) heat conduction option, and (12) solid element analysis. Mathematical models, block diagrams, tables of data, and graphs are included to clarify the theoretical aspects. P.N.F.

N72-29920*# National Aeronautics and Space Administration, Washington, D.C.
THE NASTRAN THEORETICAL MANUAL (LEVEL 15)
Richard H. MacNeal, ed. Apr. 1972 601 p
(NASA-SP-221(01)) Avail: NTIS; Computer Software Management and Information Center, Barrows Hall, University of Georgia, Athens, Georgia 30601 $6.00 CSCL 13M

The theoretical manual for the NASA Structural Analysis (NASTRAN) program is presented. The organizational aspects of NASTRAN and the utility matrix routines are discussed. Dynamic structural analysis techniques are examined. Information is included on computer graphics, special structural modeling techniques, and error analysis. Author

N72-29921*# National Aeronautics and Space Administration, Washington, D.C.
THE NASTRAN USER'S MANUAL (LEVEL 15)
Caleb W. McCormick, ed. Jun. 1972 1540 p
(NASA-SP-222(01)) Avail: NTIS HC (individually priced); Computer Software Management and Information Center, Barrows Hall, University of Georgia, Athens, Georgia 30601 $10.00 CSCL 13M

The User's manual for the NASA Structural Analysis (NASTRAN) program is presented. The manual contains all information needed to solve problems with NASTRAN. The volume is instructional and encyclopedic. The manual includes instruction in structural modeling techniques, instruction in input preparation, and information to assist the interpretation of the output. Descriptions of all input data cards, restart procedures, and diagnostic messages are developed. Author

N72-29922*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A PRELIMINARY INVESTIGATION OF PROJECTILE SHAPE EFFECTS IN HYPERVELOCITY IMPACT OF A DOUBLE-SHEET STRUCTURE
Robert H. Morrison Washington Aug. 1972 13 p refs
(NASA-TN-D-6944; A-4394) Avail: NTIS HC $3.00 CSCL 20K

Impact tests of a sphere and several cylinders of various masses and fineness ratios, all of aluminum, fired into an aluminum double-sheet structure at velocities near 7 km/sec, show that a cylinder, impacting in the direction of its axis, is considerably more effective as a penetrator than a sphere. Impacts of three cylinders of equal mass, but different fineness ratios, produced holes through the structures' rear sheet, whereas impact of a sphere of the same mass did not. Moreover, it was found that to prevent rear-sheet penetration, the mass of the 1/2-fineness-ratio cylinder had to be reduced by a factor greater than three. Further tests wherein the cylinder diameter was held constant while the cylinder length was systematically reduced showed that a cylinder with a fineness ratio of 0.07 and a mass of only 1/7 that of the sphere was still capable of producing a hole in the rear sheet. Author

N72-29923*# AiResearch Mfg. Co., Los Angeles, Calif.
THERMAL AND STRUCTURAL TESTS OF A HYDROGEN COOLED PANEL
C. E. Richard, J. D. Duncan, E. W. Gellersen, and C. Demogenes Washington NASA Aug. 1972 56 p refs
(Contract NAS1-5002)
(NASA-CR-2105; Rept-70-7040) Avail: NTIS HC $3.00 CSCL 20M

An experimental evaluation of the thermal and structural performance of a hydrogen-cooled panel is presented. The panel, which was of brazed Inconel 625 and Inconel 718 construction, was designed for a heat flux of 100 BTU per second-foot squared and an external surface pressure of 100 psi. Author

N72-29924# Lockheed Missiles and Space Co., Palo Alto, Calif.
IMPACT BUCKLING OF ELASTIC SYSTEMS
B. A. Gordienko [1972] 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Tverd. Tela, no. 4, 1971 p 109-115
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The behavior of elastic rods and closed shells of revolution subjected to an axial impact load is considered. Under definite conditions, the rod or shell loses the stability of the initial mode with the formation of transverse (radial) deflections. The process of dynamical buckling of elastic systems is studied in specific examples, and a regularity for the transverse wave formation is established. Author

N72-29925# Lockheed Missiles and Space Co., Palo Alto, Calif.
DYNAMIC STABILITY OF AXISYMMETRICALLY HEATED FIBERGLASS CYLINDRICAL SHELLS REINFORCED WITH ELASTIC CYLINDERS
O. N. Ivanov and V. P. Ioseliani [1972] 7 p refs Transl. into ENGLISH from Mekhan. Polimerov, Akad. Nauk Latv. SSR (Riga), no. 2, 1972 p 331-337
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The dynamic stability of fiberglass shells loaded by a pulsating longitudinal force and an external uniformly distributed loading is considered. The shells are orthotropic, the elastic properties depend on the temperature, and vary along the thickness of the wall. Three boundary conditions are investigated. Numerical analyses are included to support the theoretical considerations. Author

N72-29926# Lockheed Missiles and Space Co., Palo Alto, Calif.
THEORY OF RELIABILITY AND LONGEVITY OF STRUCTURES
V. V. Bolotin [1972] 84 p refs Transl. into ENGLISH from the book 'Primenenie Metodov Teorii Veroiatnostei i Teorii nadezhnosti v Raschetakh Sooruzhenii' Stroiizdat, Moscow, 1971 p 152-245
Avail: NTIS HC $6.25; National Translations Center, John Crerar Library, Chicago, Ill. 60616

A theory of reliability of constructions in considered, based on representing the behavior of the construction as a random process, and the ultimate state as a random excursion from the domain of the admissible states. A complex description of the reliability theory including a probabilistic assignment of the external effects, the estimate of the probability of trouble free system operation, a schematization of the system, the solution of the statical dynamics problem for this system, and the averaging of this probability over the set of effects and system is presented. Author

N72-29927# Technische Hochschule Stuttgart (West Germany). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen.
DESIGN AND APPLICATION OF INTERACTIVE PROGRAM SYSTEMS [ENTWURF UND ANWENDUNG INTERAKTIVER PROGRAMMSYSTEME]
I. Grieger 1972 31 p refs In GERMAN Presented at the DFVLR Symp. on Bildverarbeitung und Interaktive Systeme, Oberpfaffenhofen, West Ger., 10 Dec. 1971
(ISD-121) Avail: NTIS HC $3.75

Principles for the design of interactive computer systems are discussed and an application in the field of aircraft fuselage calculation is presented. The interactive system, based on a graphic display terminal, and enabling the three dimensional display of structural members using the finite element method, is described in terms of hardware and software. An application is given in the design of a sandwich fuselage demonstrating the possibility of modification. ESRO

N72-29928# Technische Hochschule Stuttgart (West Germany). Inst. fuer Statik und Dynamik der Luft- und Raumfahrtkonstruktionen.
PARAMETRIC INVESTIGATIONS OF NOTCHES WITH THE MATRIX DISPLACEMENT METHOD AND VIDEO SCREEN SUPPORT [PARAMETRISCHE UNTERSUCHUNGEN VON KERBEN MIT DER MATRIZENVERSCHIEBUNGSMETHODE UND BILDSCHIRMUNTERSTUETZUNG]
J. H. Argyris and I. Grieger 1972 25 p refs In GERMAN Presented at the 6th Schweisstech. Hochschulkolloq., Essen, 17 Mar. 1972
(ISD-122) Avail: NTIS HC $3.00

It is demonstrated that the finite element method, formulated as matrix displacement method, can be used to calculate stress concentrations in notched structural members with interaction computer techniques. For calculation of stress concentrations, as they occur in many structures, it is found that the simple elements are no longer sufficient, but elements with a higher than constant elongation are necessary. A further improvement is the introduction of elements with curved edges. Often several parameters need modification and an interactive computer display method is proposed to realize this. ESRO

N72-29929# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
EXPERIMENTAL STUDIES ON BUCKLING OF 7075-T6 ALUMINUM ALLOY INTEGRALLY STRINGER STIFFENED SHELLS
Tanchum Weller and Josef Singer Oct. 1971 74 p refs
(Contract F61052-69-C-0040; AF Proj. 9782)
(AD-740546; TAE-135; AFOSR-72-0867TR; SR-2) Avail: NTIS CSCL 20/11

An experimental study of the buckling of closely spaced integrally stringer-stiffened cylindrical shells under axial compression was carried out to determine the influence of shell and stiffener geometry on the applicability of linear shell theory. 38 specimens fabricated from 7075-T6 aluminum alloy with different geometries were tested. Most test specimens were designed to fail in general instability and under low critical stresses to assure elastic buckling. Agreement of experiments with linear theory was found to be governed primarily by the stringer area parameter, (A (1)/bh) and the shell geometry parameter, Z. Values of linearity, rho, (ratio of experimental buckling load to the predicted one) higher than 80% were obtained in the ranges $Z > 1000$ and $(Al/bh) > 0.5$ and a clear trend towards $rho = 1$ was observed with increasing values of these parameters. Correlation with linear theory was also found to be influenced by panel unstable postbuckling behavior.
Author (GRA)

N72-29930# Watervliet Arsenal, N.Y. Benet Weapons Lab.
TRANSVERSELY ISOTROPIC BEAMS UNDER INITIAL STRESS
Eugene J. Brunelle Apr. 1972 33 p refs
(DA Proj. 1T0-61101-A-91-A)
(AD-740739; WVT-72) Avail: NTIS CSCL 13/13

A linearized theory of transversely isotropic beams, which accounts for initial non-uniform states of stress, is derived by perturbing and averaging (thru the thickness) the non-linear equations of elasticity. This theory provides a rigorous foundation

for previously derived linear equations as well as displaying some new features concerned with the stability and vibration of beams acted upon by a variety of initial stresses. A comparison is made to a previous theory (suitably one-dimensionalized) by Herrmann and Armenakas which was obtained by variational methods and, although the results are vaguely similar, surprising differences are found which support a previous criticism of Masur.
Author (GRA)

N72-29931# Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
A COMPARISON OF THEORY AND EXPERIMENTS ON THE DYNAMIC PLASTIC BEHAVIOR OF SHELLS
Norman Jones and R. M. Walters Nov. 1971 34 p refs
(Contract N00014-67-A-0204-0032; NR Proj. 064-510)
(AD-740199; Rept-71-16) Avail: NTIS CSCL 20/11

A comparison is made between the predictions of an approximate theoretical rigid-plastic procedure and some experimental values of the permanent deflections of hemispherical shells and cylindrical shell panels loaded impulsively. The initial kinetic energy of the dynamic loads in these tests was considerably larger than the maximum amount of strain energy which the shells could absorb in a wholly elastic manner. It emerged that reasonable agreement was obtained for the strain rate insensitive shells examined which should provide encouragement for the further development of these approximate procedures.
Author (GRA)

N72-29932# Lockheed Missiles and Space Co., Palo Alto, Calif. Palo Alto Research Lab.
PROCEEDINGS OF A CONFERENCE ON COMPUTER ORIENTED ANALYSIS OF SHELL STRUCTURES
Richard F. Hartung Jun. 1971 1304 p refs Conf. held at Palo Alto, Calif., 10-14 Aug. 1971
(Contract F33615-69-C-1523; AF Proj. 1467)
(AD-740547; AFFDL-TR-71-79) Avail: NTIS CSCL 20/11

The Conference on Computer Oriented Analysis of Shell Structures, sponsored jointly by Lockheed Missiles and Space Company and Air Force Flight Dynamics Laboratory, was held at the Lockheed Palo Alto Research Laboratory in Palo Alto, California, on 10-14 August 1971. The primary objective of the conference was to bring together specialists in the field of computer analysis of shells and shell-like structures for an exchange of information through the presentation of papers, panel discussions and informal discussions. Particular emphasis was placed on recent developments in discrete methods for analyzing the static and dynamic response of shell structures and on the related problems of computer technology, numerical analysis and applications to engineering problems. Author (GRA)

N72-29933# Northwestern Univ., Evanston, Ill. Structural Mechanics Lab.
A THEORY OF ELASTICITY WITH MICROSTRUCTURE FOR FIBER REINFORCED COMPOSITES
Jan D. Achenbach and Chin-Teh Sun Jan. 1972 30 p refs
(Contract N00014-67-A-0356-0014; NR Proj. 064-483)
(AD-740219; TR-72-1) Avail: NTIS CSCL 20/11

A theory of elasticity with microstructure is developed to describe the mechanical behavior of fiber-reinforced composites. The theory is based on expansions of the displacements across representative cells. The transition from the actually inhomogeneous composite to a homogeneous continuum is achieved by introducing continuous fields for gross displacements and local deformations. Subsequent to the derivation of strain energy and kinetic energy densities a system of displacement equations of motion is obtained by means of Hamilton's principle. The governing equations are employed to examine the propagation of transverse waves propagating in the direction of the fibers. Curves are shown which relate the phase velocity and the wavenumber.
Author (GRA)

N72-29934# Ballistic Research Labs., Aberdeen Proving Ground, Md.
FORMULATION OF THE LARGE DEFLECTION SHELL EQUATIONS FOR USE IN FINITE DIFFERENCE STRUCTURAL RESPONSE COMPUTER CODES
Joseph M. Santiago Feb. 1972 139 p refs
(DA Proj. 1TO-61102-A-14B; DA Proj. 1WO-62118-AD-51)
(AD-740742; BRL-1571) Avail: NTIS CSCL 20/11

A formulation of the equations governing the large transient deformation of Kirchhoff shells especially suitable for use in finite difference structural response codes is presented. It is shown how these equations are employed in REPSIL, a computer code developed at the BRL for predicting the large deflection of thin elastoplastic shells subjected to blast and impulse loadings. The REPSIL formulation is compared with the somewhat similar formulations used by PETROS 1 and PETROS 2, two closely related codes developed by MIT.
Author (GRA)

N72-29935# Catholic Univ. of America, Washington, D.C. Inst. of Ocean Science and Engineering.
RESPONSE OF OVERSIZED EPOXY STRAND MODELS TO AXIAL, TORSIONAL AND BENDING LOADS
A. J. Durelli and S. Machida Feb. 1972 45 p refs
(Contract N00014-68-A-0506-0001)
(AD-740378; Rept-72-2) Avail: NTIS CSCL 13/9

Axial, torsional and bending loadings have been applied to the models. Strains, stresses and displacements have been determined using mechanical and electrical strain gages, dial gages and brittle coatings. In the case of axial and torsional loadings, the results obtained are compared with calculations using a previously developed theory. The response of a reference structure in which each wire is assumed to act independently is also compared with the response of the strand.
Author (GRA)

N72-29936# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
BUCKLING OF A CIRCULAR CYLINDRICAL WEB-STIFFENED SANDWICH SHELL UNDER AXIAL COMPRESSION
Vincent Volpe, Youl-Nan Chen, and Joseph Kempner Mar. 1972 47 p refs
(Contract N00014-67-A-0438-0006; NR Proj. 064-427)
(AD-740135; PIBAL-72-8) Avail: NTIS CSCL 20/1

Presented herein is a stability analysis of an infinitely long web-stiffened, circular cylindrical sandwich shell under uniform axial compression. The formulation begins with the establishment of a set of suitable large-deflection shell equations that form the basis for the subsequent development of the buckling equations. The mathematical model corresponds to two face layers which are considered as thin shells and a thick core which is capable of resisting both transverse shear and circumferential extension. The associated eigenvalue problem is solved. Results show that the lowest buckling load is associated with the axisymmetric mode rather than the asymmetric modes.
Author (GRA)

N72-29937# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
FLEXURE OF A BEAM SUPPORTED ON AN ELASTIC FOUNDATION M.S. Thesis
Ronald William Feiken Mar. 1972 89 p refs
(AD-741453; GSF/MC/72-4) Avail: NTIS CSCL 13/13

The thesis presents a technique for analyzing the flexure of a beam supported on an elastic foundation, which does not allow normal tensile stresses at the interface, using the finite element method. The technique presented can be used in instances where the shape of the beam or foundation is irregular and where the beam or foundation is nonhomogeneous. The beam and foundation are represented by elements that have displacement functions that vary as the third-degree of Y and the fifth-degree of X.
Author (GRA)

N72-29938# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
BUCKLING ANALYSIS OF LAMINATED ANISOTROPIC CYLINDERS UNDER COMBINED LOADING M.S. Thesis
Brian A. Kosmal Jun. 1971 79 p refs
(AD-741455; GAW/MC/71-10) Avail: NTIS CSCL 20/11

A linear shell theory, in general laminate form, describing the buckling behavior of thin-walled laminated anisotropic circular cylinders under combined loading is derived from elasticity theory. The theory incorporates the well-known Donnell's approximations. The theory is then applied to cylinders fabricated of plys with fibers oriented at angles of zero degrees and 90 degrees with respect to the cylinder axis. The loading scheme considered is that of combined internal (or external) pressure and axial tension (or compression). Fourier series solutions are assumed and the boundary condition of clamped ends is incorporated using principles of Fourier analysis. Author (GRA)

N72-29939# Naval Research Lab., Washington, D.C.
INTRODUCTION TO THE J INTEGRAL
Frank J. Loss 1 Mar. 1972 18 p refs
(Contract AT(49-5)-2110; NRL Proj. M01-14; MIPR 41004; RR02211415409)
(AD-741675; NRL-MR-2411) Avail: NTIS CSCL 11/6

Current research programs center on various analysis concepts of the elastic plastic toughness regime. One of these, the J integral, is a relatively new analytical concept with which little experimental investigation has been attempted to date. Yet the approach appears to offer the prospect of significant near term advances in characterization of the elastic plastic regime. The paper provides an introduction to the J integral in terms for one who is not actively engaged in the field. The description of the J integral includes the advantages of this approach as a failure criterion as well as its limitations. Author (GRA)

N72-29940# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ROUGH SURFACES IN CONTACT
N. B. Demkin 25 Feb. 1972 298 p refs Transl. into ENGLISH from the monograph "Kontaktirovanie Sherokhovatykh Poverkhnostei" 1970 p 1-227
(AD-741484; FTD-HC-23-355-71) Avail: NTIS CSCL 20/11

The book presents the results of theoretical and experimental investigations of the contact between solids, taking into account their surface microgeometry. Various models of asperities on rough surfaces are considered, and the deformation of the contact area is calculated. A survey of the experimental techniques used to determine the characteristics of contact between machine parts is given. Computational procedures are given that can be used to calculate the real and contour areas of contact, rigidity of contact, volume of the air gap between surfaces, mean diameter of contact sports, etc. Author (GRA)

N72-29941# Princeton Univ., N.J. Frick Chemical Lab.
AN IMPROVED NUMERICAL INTERCONVERSION FOR CREEP COMPLIANCE AND RELAXATION MODULUS
Warren F. Knoff and Irving L. Hopkins Apr. 1972 25 p refs
(Contract N00014-67-A-0151-0011; NR Proj. 056-377)
(AD-741235; RLT-134) Avail: NTIS CSCL 20/11

An improved method for the numerical evaluation of the convolution integral in the relationship between creep compliance and relaxation modulus is discussed. The better approximation is obtained by the assumption that both functions can be assumed to be linear within a series of increasing time intervals which do not change as the calculation progresses. The calculation is carried out on both hypothetical and real examples which substantiates its applicability and accuracy. Author (GRA)

N72-29942# Iowa Univ., Iowa City. Coll. of Engineering.
DYNAMIC OPTIMIZATION OF VEHICULAR STRUCTURES
J. S. Arora, W. F. Ames, D. T. Davy, E. J. Finck, and G. M. Lance Apr. 1972 38 p refs
(Contract DAAF03-69-C-0014; Proj. Themis)
(AD-741393; THEMIS-UI-40) Avail: NTIS CSCL 13/6

In the report, optimal design of vehicular structures with respect to their dynamic performance is considered. The problem of optimal design is stated precisely in mathematical terms. The iterative optimization procedure is based on the necessary conditions of the calculus of variations. A simple two degrees of freedom model is considered and a minimax principle is used which reduces the problem to that of finite dimensional nonlinear programming problem. The objective function for this problem consists of various absolute maximum values of velocities and accelerations. The results for various cases of this problem are presented. Finally, the listing of the computer program is given in an appendix. Author (GRA)

N72-29943# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.
COMBINED MODE CRACK EXTENSION IN ADHESIVE JOINTS
G. G. Trantina Nov. 1971 45 p refs
(Contract N00019-71-C-0323)
(AD-741687; T/AM-352) Avail: NTIS CSCL 13/5

The study investigates crack extension in an adhesive system under combined mode loading. A finite element stress analysis for a slant edge-cracked plate furnishes the opening and shear mode stress intensity factors over a wide range of slant angles and crack lengths. By varying the angle between the adhesive layer and the load line in a SEN specimen, combined mode crack extension is observed and the combined mode fracture toughness values are then determined. The effect of the location of the crack tip (center of bond or interface) is also discussed. Author (GRA)

N72-29944# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
SETTLING OF STRUCTURES ON THAWING GROUND
G. I. Lapkin Apr. 1972 10 p refs Transl. into ENGLISH from Promyshlennde Stroitelstuo (USSR), v. 19, no. 7/8, Jul./Aug. 1941 p 27-29
(AD-741057; CRREL-TL330) Avail: NTIS CSCL 13/13

During construction on permafrost the question concerning the amount of forthcoming settlings has unique significance. An estimation of these settlings can be made on the basis of experiments with hot punches. The study examines a procedure for testing with punches. According to this techique, the soil's thawing is envisaged by means of heating the water poured into a test borehole for a depth of 20-30 cm above a sandy filling (20-30 cm) which covers the borehole bottom after the placement of the punch. Heating the water begins after loading the punch with the planned weight. Thawing continues until stabilization of the settlings. Author (GRA)

N72-29945# Lehigh Univ., Bethlehem, Pa. Center for the Application of Mathematics.
INSTABILITY OF AN ELASTIC MATERIAL
K. N. Sawyers and R. S. Rivlin Mar. 1972 22 p refs
(Contract N00014-67-A-0370-0001)
(AD-741190; CAM-100-14) Avail: NTIS CSCL 20/11

Conditions are derived which are necessary for stability of incompressible elastic materials. These are obtained by considering the speeds of small-amplitude plane waves superposed on a finitely deformed state of the material. Author (GRA)

N72-29946# North Carolina State Univ., Raleigh. Dept. of Mathematics.
THE TRANSMISSION OF FORCE BETWEEN TWO HALF-PLANES
Ian N. Sneddon 14 Apr. 1972 32 p refs
(Grant AF-AFOSR-1779-69; AF Proj. 9749)
(AD-740868; AFOSR-72-0959TR) Avail: NTIS CSCL 20/11

Consideration is given to the problem of determining the distribution of stress in a composite solid consisting of two

half-planes (of different elastic moduli) joined together when there is a prescribed distribution of body forces acting in one of them. Included are four cases: where one half-plane rests on the other, maintaining contact along their common boundary, where the two half-planes are bounded together, where an imperfect bond leaves a Griffith crack at the interface, and where the lower half-plane is completely rigid. Author (GRA)

N72-29947# State Univ. of New York at Buffalo. Dept. of Engineering Science.
STEADY CREEP BENDING IN A BEAM WITH RANDOM MATERIAL PARAMETERS
Francis A. Cozzarelli and Wen Nan Huang Jan. 1972 33 p refs
(Contract N00014-71-C-0108; Grant NSF GK-1834X)
(AD-741678; Rept-59) Avail: NTIS CSCL 13/13

A statistical analysis is presented for steady creep bending in a beam, where the material parameters are random processes along the neutral axis arising from random fluctuations in temperature and imperfection density. Analytical and numerical results are presented for the statistical properties of the normal stress and lateral velocity. It is found that whereas the normal stress shows very little random fluctuation the lateral velocity is highly random. The statistics of the lateral velocity generally show a significant dependence on the nominal value of the creep power and on the position along the neutral axis. Author (GRA)

N72-29948# State Univ. of New York at Buffalo. Dept. of Engineering Science.
DAMPED LATERAL VIBRATION IN AXIALLY CREEPING BEAM WITH RANDOM MATERIAL PARAMETERS
Wen Nan Huang and Francis A. Cozzarelli Feb. 1972 53 p refs
(Grant NSF GK-1834X)
(AD-741680; Rept-78) Avail: NTIS CSCL 13/13

Damped lateral vibration in an axially creeping beam with random material parameters is considered. The temperature and imperfection density and as a result two inelastic material parameters are random functions of the distance along the neutral axis. It is assumed that the material of the beam is governed by a nonlinear Maxwell model, and that the initial tensile stress is much greater than the increment of stress caused by the oscillation so that a perturbation technique may be employed. Two special cases are fully analyzed: the random parameters are random processes which are only slightly random, and the random parameters are random variables which are largely random. Author (GRA)

N72-29949# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRINCIPLES OF THE MATHEMATICAL THEORY OF THERMOVISCOELASTICITY
A. A. Ilyushin and B. E. Pobedrya 10 Feb. 1972 410 p refs Transl. into ENGLISH of "Osnovy Mathematicheskoy Teorii Thermovyazko-Uprugosti" Moscow, Izd. Nauka, 1970 p 1-280
(AD-740213; FTD-MT-24-919-71) Avail: NTIS CSCL 20/11

The report deals with mechanics and thermodynamics of continuous deformable bodies and media in visco-elastic conditions at constant and variable temperatures taking into account heat formation. Discussed are static and quasistatic flow as well as dynamic processes in isotropic and anisotropic bodies at low and finite deformations. The theory of accumulation of macroscopic uniform fatigue damage is given, and an effective method for the solution of problems in the linear and nonlinear theory of thermoviscoelasticity (the approximation method) is discussed with examples of interesting calculations of strength and deformability of disks, cylinder and plates. Author (GRA)

N72-29950# Naval Postgraduate School, Monterey, Calif.
OPTIMIZATION OF BEAMS FOR LATERAL BUCKLING M.S. Thesis
Robert Louis Burns Dec. 1971 128 p refs
(AD-741121) Avail: NTIS CSCL 13/13

The treatise seeks to find the optimum shape of a thin beam under the influence of lateral buckling. The specific formulation is by means of the isoperimetric problem of the calculus of variations. An energy method approach yields the governing equations for the problem. An analytic solution was not obtained due to the nonlinearity and coupling conditions of the equations. A variable height lateral buckling problem is formulated as an alternate attempt to find the optimum design. Through Bessel equation analysis numerous designs are obtained and the resulting buckling loads are calculated. The largest buckling load corresponds to a beam design which appears to be very close to the optimum shape. Author (GRA)

N72-29951# Cornell Univ., Ithaca, N.Y. Dept. of Theoretical and Applied Mechanics.
BOND FAILURE BETWEEN ELASTIC PLATES AND RIGID BODIES
A. Jahanshahj Apr. 1972 29 p refs
(Contract N00014-67-A-0077-0009; NR Proj. 064-401)
(AD-741209; TR-12) Avail: NTIS CSCL 20/11

Employing the Timoshenko beam theory, the classical theory of flexural motions of thin plates and the theory of elasticity, the problem of continuous failure of bond between a thin elastic plate and a rigid body is studied. The bond failure is due to line and point forces moving on the plate. Author (GRA)

N72-29952# Army Foreign Science and Technology Center, Charlottesville, Va.
BUCKLING OF PLATES OF INHOMOGENEOUS MATERIAL WITH ELASTO-PLASTIC DEFORMATIONS
A. I. Strelbitskaya, V. A. Kolgadin, and S. I. Matoshko 13 Apr. 1972 14 p refs Transl. into ENGLISH from Prikl. Mekh. (Kiev), v. 5, no. 11, 1969 p 54-61
(AD-742158; FSTC-HT-23-316-72) Avail: NTIS CSCL 13/13

The elasto-plastic buckling of rectangular plates made of inhomogeneous material when the modulus of elasticity, or shear modulus, and yield point change through the thickness of the plate, is examined. The elastic solutions method in combination with the finite differences and variation methods is used to solve the problem on the basis of the Kirchhoff-Love hypothesis. The condition of plasticity is considered in accordance with the energy theory and the material of the plates is assumed to be incompressible. Author (GRA)

N72-29953# Army Foreign Science and Technology Center, Charlottesville, Va.
SPATIAL DYNAMICS PROBLEM OF THE THEORY OF ELASTICITY FOR A MULTIPLY CONNECTED AREA
N. A. Shulga 1 Feb. 1972 10 p refs Transl. into ENGLISH from Prikl. Mekh. (Kiev), v. 5, no. 11, 1969
(AD-741879; FSTC-HT-23-317-72) Avail: NTIS CSCL 20/11

An infinitely elastic cylinder with a finite number of longitudinal cylindrical cavaties (inclusions) is studied. Infinite systems of equations are produced, having the same structure as the infinite systems for the planar problem and their coefficients allow similar estimates. This indicates that the systems are quasiregular. Author (GRA)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N72-29954*# Explosive Technology, Inc., Fairfield, Calif.
A STUDY OF AN ADVANCED CONFINED LINEAR ENERGY SOURCE
M. C. Anderson and W. B. Heidemann [1971] 47 p refs
(Contract NAS1-9984)
(NASA-CR-112096) Avail: NTIS HC $4.50 CSCL 19A

A literature survey and a test program to develop and evaluate an advanced confined linear energy source were conducted. The advanced confined linear energy source is an explosive or pyrotechnic X-Cord (mild detonating fuse) supported inside a confining tube capable of being hermetically sealed and retaining all products of combustion. The energy released by initiation of the X-Cord is transmitted through the support material to the walls of the confining tube causing an appreciable change in cross sectional configuration and expansion of the tube. When located in an assembly that can accept and use the energy of the tube expansion, useful work is accomplished through fracture of a structure, movement of a load, reposition of a pin, release of a restraint, or similar action. The tube assembly imparts that energy without release of debris or gases from the device itself. This facet of the function is important to the protection of men or equipment located in close proximity to the system during the time of function. Author

N72-29955*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND EVALUATION OF AN OXIDANT-FUEL-RATIO-ZONED ROCKET INJECTOR FOR HIGH PERFORMANCE AND ABLATIVE ENGINE COMPATIBILITY
Jerry M. Winter, Albert J. Pavli, and Arthur M. Shinn, Jr. Washington Aug. 1972 59 p refs
(NASA-TN-D-6918; E-6945) Avail: NTIS HC $3.00 CSCL 20M

A method for temperature control of the combustion gases in the peripheral zone of a rocket combustor which would reduce ablative throat erosion, prevent melting of zirconia throat inserts, and maintain high combustion performance is discussed. Included are techniques for analyzing and predicting zoned injector performance, as well as the philosophy and method for accomplishing an optimum compromise between high performance and reduced effective gas temperature. The experimental work was done with a 1000-lbf rocket engine which used as propellants N2O4 and a blend of 50-percent N2H4 and 50-percent UDMH at 100-psia chamber pressure and an overall O/F of 2.0. The method selected to provide temperature control was to use 30 percent of the propellant to form a peripheral zone of combustion gases at an O/F of 1.31 and 2700 K. The remaining 70 percent of the propellant in the core was at an O/F of 2.45 to keep the overall O/F at 2.0. Author

N72-29956# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
THE ROLE OF MIXING IN BURNER GENERATED CARBON MONOXIDE AND NITRIC OXIDE
Francesco Pompei and John B. Heywood Feb. 1972 37 p refs
(Grant EPA-5-R01-AP01-02-APC)
(Publ-72-2) Avail: NTIS HC $4.00

Nonuniformities and rates of mixing are found to play an important role in determining emissions of carbon monoxide and nitric oxide from a kerosene-fueled atmospheric-pressure burner. Nonuniformities are allowed for by assuming that burnt gas eddies have a normal distribution of equivalence ratios about the mean value. Mixedness is characterized by the ratio of the standard deviation of this distribution to the mean value and is related to combustor operating variables. A simple one-dimensional flow model is coupled with the mixing model to predict the variation of CO and NO concentrations with atomizing pressure and distance along the burner. The data obtained agree with the predictions and show clear mixing effects on both CO and NO concentration levels. Author

N72-29957*# Scientific Translation Service, Santa Barbara, Calif.
THE EFFECT OF ELECTRIC FIELDS ON THE HEAT TRANSFER IN GASES
Hermann Senftleben and Ewald Bultmann Washington NASA Aug. 1972 14 p refs Transl. into ENGLISH from Z. Physik (Berlin), v. 136, 1953 p 389-401
(Contract NASw-2035)
(NASA-TT-F-14397) Avail: NTIS HC $3.00 CSCL 20M

The effect of electric fields on the heat transfer in gases is analyzed. The increase in heat transfer is caused by electrostriction which occurs in the electric field which causes an amplification of the convection flow in the gas. The analysis is presented in the form of dimensionless numbers. Equations of the thermodynamic processes are included. Author

N72-29958# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Abteilung Staustrahl- und Kombinationsan- Triebe.
COMPUTATION OF THE OPERATION OF HOT WATER STORAGE VESSELS Ph. D. Thesis - Tech. Univ. Brunswick [ZUR BERECHNUNG DER ARBEITSWEISE VON HEISSWASSERSPEICHERN]
Helmut Hardegen Mar. 1972 174 p refs In GERMAN; ENGLISH summary
(DLR-FB-72-24) Avail: NTIS HC $10.75; DFVLR, Porz 37,20 DM

An exact differential equation is derived from which the states in a hot water storage vessel are computed during the extraction of steam or water. It is shown that existing computation methods are simplifications of the exact differential equation. Because a complete analytical integration is not possible the interpretation is accomplished by numerical means, but serious difficulties also arise in this case. Therefore a step-by-step method is presented which allows in a simple way the computation of the state in a hot water storage vessel, even during the extraction process. Heat transfer and the presence of an inert gas (air) are considered. ESRO

N72-29959# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
DEVELOPMENT OF A PLANAR HEAT PIPE FOR COOLING LARGE CAPACITY BATTERIES
E. T. Mahefkey, Jr. Dec. 1971 94 p refs
(AF Proj. 3145)
(AD-740552; AFAPL-TR-71-39) Avail: NTIS CSCL 13/1

A planar (rectangular cross section) heat pipe was fabricated and tested using electrical heaters to simulate battery waste heat. The device was constructed of 0.025 in. stainless steel, with two layers of 100-mesh stainless steel screen as a capillary wick; water was used as the working fluid. Transient and steady state response was investigated. External axial temperature profiles were measured for 5, 12, and 20 watts applied power; internal evaporator and condenser temperatures were also measured. Operation of the device was stable and repeatable within a temperature range of 50 to 180 F; no temperature or pressure fluctuations were noted. Author (GRA)

N72-29960# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VIBRATIONAL RELAXATION IN THE PRODUCTS OF HYDROCARBON FUEL COMBUSTION
V. N. Arkhipov 6 Jan. 1972 10 p refs Transl. into ENGLISH from the publ. "Teplofizicheskie Svoistva Zhidkostei i Gazov pri Vysokikh Temperaturakh i Plazmy, 25-30 Jul. 1966, Vol. 2" 1969 p 371-373
(FTD-AAH9)
(AD-740193; FTD-HT-23-1221-71) Avail: NTIS CSCL 21/2

The oscillating relaxation time in the combustion products of a hydrocarbon fuel as it flows from a nozzle under supersonic flow conditions was calcualted. For certain components the duration of the oscillating relaxation is comparable to the characteristic gas dynamic duration of flow. This leads to the fact that the oscillating temperature of the gases at the output of the nozzle essentially exceeds the progressive temperature.
Author (GRA)

N72-29961# Naval Postgraduate School, Monterey, Calif.
A COMPUTER PROGRAM FOR SOLVING TRANSIENT HEAT CONDUCTION PROBLEMS M.S. Thesis
Coskun Erbayram Dec. 1971 128 p refs
(AD-741070) Avail: NTIS CSCL 20/13

A computer program, with the code name TRUMP, was developed in 1965 by the Lawrence Livermore Laboratory to solve a variety of transient and steady-state conduction heat flow problems in simple or complicated geometric configurations. The purpose of this investigation was to adapt TRUMP to the Naval Postgraduate School IBM/360 Model 67 computer system. Several heat conduction problems are solved with the adapted version of TRUMP and the results compare closely with the analytical solutions to these problems. The example problem inputs may be used as guides in preparing input data for future problems. Some suggestions are also given for further development of the program. Author (GRA)

N72-29962# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A STUDY OF NONEQUILIBRIUM EFFECTS ON IGNITION DELAY IN A SUPERSONIC AIRSTREAM M.S. Thesis
Donald M. Teasdale Mar. 1972 61 p refs
(AD-741581; GAM/ME/72-1) Avail: NTIS CSCL 21/2

The purpose of the study was to determine analytically the effects of water vapor on the ignition delay process in the burning of gaseous hydrogen in a supersonic flowing vitiated airstream. A low temperature (950 - 1000 K) regime was used so the reaction rates would dominate over the diffusion rates. In the study two chemical kinetic computer programs were used to analytically predict the ignition delay times using the inputs from seven vitiated-air heater experimental investigative conditions. The analytically calculated ignition delay times, for the seven comparitive clean-air and vitiated-air cases, were then compared to the experimental results to determine the effects of water vapor on the ignition delay time. Author (GRA)

N72-29963# Army Foreign Science and Technology Center, Charlottesville, Va.
TRANSITIONAL HEAT REGIME REALIZABLE ON ACCOUNT OF BEAM ENERGY TRANSFER IN SCATTERING MEDIA
B. I. Stepanov 18 Apr. 1972 10 p ref Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Mink), v. 14, no. 10, 1970
(AD-741050; FSTC-HT-23-402-72) Avail: NTIS CSCL 20/13

In numerous dispersion media (powders of different materials, hydrosol and aerosol systems) where the contact between the isolated particles is small or nonexistent, the heat regime is realized basically on account of the transfer of radial energy. An equation of thermal conductivity is presented for the above. This equation in combination with the transfer equation, is written out for the spectral density of space illumination, allows in principle to research the transitional heat regime. However, the analytical solution of the problem is only possible for a limited number of situations. Some of these are examined. Author (GRA)

N72-29964# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THERMAL EFFECTS WHICH MAY RESULT IN THE UNEXPECTED IGNITION OF GASEOUS MIXTURES
James T. Dehn Apr. 1972 26 p refs
(DA Proj. 1T0-61101-A-91-A)
(AD-741375; BRL-MR-2179) Avail: NTIS CSCL 21/2

When gases are admitted rapidly to a vessel the temperature may rise several hundred degrees in some circumstances. A simple formula involving the specific heat ratio, thermal conductivity and molecular weight of a gas is derived which successfully describes the maximum value of this temperature pulse as a function of temperature and pressure for a variety of gases. Safety applications and corrections to measurements of ignition limits and ignition delay times are discussed.
Author (GRA)

N72-29965# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
QUASI-STATIONARY THEORY OF LIQUID FUEL DROPLET IGNITION
G. A. Varshavskii, D. V. Fedoseev, and A. D. Frank-Kamenetskii 16 Feb. 1972 12 p refs Transl. into ENGLISH from Fizika Aerodispersynkh Sistem (USSR), no. 1, 1969 p 101-107
(AD-742419; FTD-HT-23-1246-71) Avail: NTIS CSCL 21/2

Analysis, in a quasistationary approximation, of the ignition of a liquid fuel droplet is described. It is shown that ignition will occur at the point where the chemical reaction rate possesses a local maximum. It is also shown that this point is characterized by a stoichiometric relation between the fuel and the oxidizer.
Author (GRA)

N72-29966# Army Foreign Science and Technology Center, Charlottesville, Va.
CERTAIN INVERSE PROBLEMS OF DETERMINING PARAMETERS AND MODELING OF HEAT EXCHANGE
G. N. Zamula and V. M. Yudin 3 Feb. 1972 13 p refs Transl. into ENGLISH from Napryasheniya v Elementakh Konstruktsii (USSR), no. 9, 1970 p 59-70
(AD-741520; FSTC-HT-23-1057-72) Avail: NTIS CSCL 20/13

An inverse problem of temperature field modeling involving a plane-parallel, long, thin panel and the shelf of a support element, heated on one side and heat-insulated on the other, is considered. This inverse problem amounts to minimizing the form of divergence of the computed laboratory and operational work piece temperature fields according to controlling effects, and resembles problems of optimal control by systems with distributed parameters, and problems of optimal work piece selection. Author (GRA)

N72-29967# Naval Air Propulsion Test Center, Trenton, N.J. Aeronautical Turbine Dept.
STUDY OF ALTITUDE AND MACH NUMBER EFFECTS ON EXHAUST GAS EMISSIONS OF AN AFTERBURNING TURBOFAN ENGINE Final Report
J. Lawrence Palcza Dec. 1971 27 p refs
(AD-741249; NAPTC-ATD-212; FAA-RD-72-31) Avail: NTIS CSCL 21/2

A TF30-P-412 augmented turbofan engine was tested at simulated altitudes and Mach numbers to determine the effects of these parameters (altitude and Mach number) on exhaust pollution emissions. Emission measurements were made over a range of engine power settings from idle to full augmentation at altitudes from sea level to 70,000 feet and a Mach number range of 0 to 1.8. There was no apparent effect on emission levels due to altitude or Mach number. Author (GRA)

N72-29968# Hercules, Inc., Cumberland, Md. Allegany Ballistics Lab.
DEVELOPMENT OF A ROCKET MOTOR BURN RATE MEASUREMENT SYSTEM Final Report, 15 Jul. 1970 - 14 Apr. 1971
W. C. Schauemann, L. S. Zajdel, and J. H. Rice Oct. 1971 106 p refs
(Contract F04611-70-C-0085)
(AD-742253; ABL-TR-71-8; AFRPL-TR-71-63) Avail: NTIS CSCL 21/2

The technique chosen to develop into a microwave burn rate sensor was that of the microwave interferometer. Microwave energy is beamed through a window in the rocket motor case and into the propellant. At the burning propellant surface, this microwave energy is reflected and beamed back through the window to a detector system. At this detector system, the combination of transmitted and reflected energy produces a standing wave of energy which is monitored by the detectors. As the burning surface moves, the standing wave will also move a proportional amount. Thus, by monitoring the motion of the standing wave, the motion of the burning surface is obtained.
Author (GRA)

34 GENERAL

Includes information of a broad nature related to industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents.

N72-29969*+ National Aeronautics and Space Administration, Washington, D.C.
NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY. SECTION 1: ABSTRACTS, JANUARY 1972
Jan. 1972 557 p refs
(NASA-SP-7039-Section-1) Avail: NTIS HC $6.00 CSCL 05B

The NASA Patent Abstracts Bibliography (PAB) is a semiannual publication of NASA containing comprehensive abstracts and indexes of NASA-owned inventions covered by U.S. patents and applications for patent. The 1892 citations included in this publication were originally published in NASA Scientific and Technical Aerospace Reports (STAR), during the period from May 1969 to December 1971. NASA PAB is published as a service to companies, firms, and individuals seeking new, licensable products for the commercial market. For the convenience of the user, each issue of NASA PAB has a separately bound Abstract Section and Index Section. The Abstract Section is divided into 34 subject categories under which are grouped appropriate NASA inventions. Each entry in the Abstract Section consists of a STAR citation accompained by an abstract and a key illustration taken from the patent or application for patent drawing. Entries are arranged in each subject category in order of the ascending NASA Accession Number originally assigned in STAR to the invention. The range of NASA Accession Numbers within this issue is printed on the inside front cover. Author

N72-29970*+ National Aeronautics and Space Administration, Washington, D.C.
NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY. SECTION 2: INDEXES, JANUARY 1972
Jan. 1972 331 p refs
(NASA-SP-7039-Section-2) Avail: NTIS HC $6.00 CSCL 05B
For abstract, see N72-29969.

N72-29971*# Research Triangle Inst., Durham, N.C.
APPLICATIONS OF AEROSPACE TECHNOLOGY IN THE ENVIRONMENTAL SCIENCES Interim Report, 11 Oct. 1971 - 10 Apr. 1972
31 May 1972 50 p refs
(Contract NASw-2343)
(NASA-CR-127787) Avail: NTIS HC $4.50 CSCL 20C

Detailed information is reported on the operations and accomplishments of the RTI Technology Application Team for the period October 11, 1971 to March 10, 1972. Mathematical models for prediction of pollutant formation during combustion are discussed along with generic areas of air pollution problems, which NASA technology offers a high potential for solving. Recommendations for future work are included. F.O.S.

N72-29972*# George Washington Univ., Washington, D.C. Medical Center.
TECHNOLOGY APPLICATIONS Annual Report
Todd Anuskiewicz, John Johnston, William Leavitt, and Robert R. Zimmerman May 1972 117 p
(Contract NASw-2055)
(NASA-CR-127789) Avail: NTIS HC $8.00 CSCL 05B

A summary of NASA Technology Utilization programs for the period of 1 December 1971 through 31 May 1972 is presented. An abbreviated description of the overall Technology Utilization Applications Program is provided as a background for the specific applications examples. Subjects discussed are in the broad headings of: (1) cancer, (2) cardiovascular disease, (2) medical instrumentation, (4) urinary system disorders, (5) rehabilitation medicine, (6) air and water pollution, (7) housing and urban construction, (8) fire safety, (9) law enforcement and criminalistics, (10) transportation, and (11) mine safety. Author

N72-29973# Washington Univ., Seattle. Dept. of Urban Planning.
URBAN AND REGIONAL PLANNING UTILIZATION OF REMOTE SENSING DATA: A BIBLIOGRAPHY AND REVIEW OF PERTINENT LITERATURE Technical Report, 1 May 1971 - 31 Mar. 1972
Frank V. Westerlund Apr. 1972 233 p refs
(Contract DI-14-08-001-12864)
(USGS-242; USGS-DO-72-019; TR-1) Avail: NTIS HC $13.75 CSCL 13B

The relationships between the capabilities of the different remote sensors and the range of data peculiar to urban planning are examined. An urban planning perspective of the remote sensing field is developed and an overview of relevant aspects of applications research is presented. A bibliography of literature related to the urban planning problem is included. P.N.F.

N72-29974# Royal Observatory, Edinburgh (Scotland).
THE ROYAL OBSERVATORY EDINBURGH 1822 - 1972
1972 39 p
Avail: NTIS HC $4.00

A historical review is presented for the Royal Observatory in Edinburgh, Scotland. The equipment, library and collections, and associated buildings are described. K.P.D.

N72-29975*# Grumman Aerospace Corp., Bethpage, N.Y.
PROGRAM MANAGEMENT AID FOR REDUNDANCY SELECTION AND OPERATIONAL GUIDELINES Final Report
P. W. Hodge, W. L. Davis, and B. Frumkin Jan. 1972 108 p ref
(Contract NAS10-7697)
(NASA-CR-128494) Avail: NTIS HC $7.50 CSCL 05A

Although this criterion was developed specifically for use on the shuttle program, it has application to many other multi-missions programs (i.e. aircraft or mechanisms). The methodology employed is directly applicable even if the tools (nomographs and equations) are for mission peculiar cases. The redundancy selection criterion was developed to insure that both the design and operational cost impacts (life cycle costs) were considered in the selection of the quantity of operational redundancy. These tools were developed as aids in expediting the decision process and not intended as the automatic decision maker. This approach to redundancy selection is unique in that it enables a pseudo systems analysis to be performed on an equipment basis without waiting for all designs to be hardened. Author

N72-29976*# National Aeronautics and Space Administration, Washington, D.C.
INDEX TO NASA TECH BRIEFS, 1971
Feb. 1972 158 p refs
(NASA-SP-5021(12)) Avail: NTIS HC $3.00 CSCL 05B

The entries are listed by category, subject, author, originating source, source number/Tech Brief number, and Tech Brief number/source number. There are 528 entries. Author

N72-29977# Joint Publications Research Service, Arlington, Va.
RUSSIAN REPORT TO FIFTEENTH COSPAR SESSION
M. I. Shtern, ed. 18 Jul. 1972 138 p Transl. into ENGLISH of the Monograph "Issledovaniya Verkhney Atmosfery i Kosmicheskogo Prostranstva. Vypolnennyye v SSSR v 1971 godu" Nauka Publishing House, Moscow, 1972 COSPAR Session held in Madrid, Apr. 1972

(JPRS-56527) Avail: NTIS HC $9.00

The report contains items on exploration of the moon and planets; space vehicles launched in the USSR in 1971; long-lived orbital station; international cooperation; biomedical research; and investigations of cosmic rays, the interplanetary medium, the magnetosphere physics, and meteorological phenomena. Author

N72-29978# Department of Transportation, Washington, D.C.
INVENTORY OF TECHNOLOGY AND PROGRAMS APPLICABLE TO CARGO SECURITY
1 Jun. 1972 40 p Prepared in cooperation with Mitre Corp., McLean, Va.
(Contract DOT-FA70WA-2448)
Avail: NTIS HC $4.00

This report assembles in one document a summary of Government programs and capabilities that are useful in protecting cargo against theft. This summary is based upon descriptions submitted by Government agencies involved in physical security research and development programs. The information is presented in essentially the format and detail submitted by the agencies; some agency descriptions have been shortened to maintain consistency, and some editorial changes were made for clarity. Author

N72-29979*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GENERAL METHODOLOGY: COSTING, BUDGETING, AND TECHNIQUES FOR BENEFIT-COST AND COST-EFFECTIVENESS ANALYSIS
D. Michael Stretchberry and Gerald F. Hein Washington Aug. 1972 20 p refs
(NASA-TM-X-2614; E-6906) Avail: NTIS HC $3.00 CSCL 05A

The general concepts of costing, budgeting, and benefit-cost ratio and cost-effectiveness analysis are discussed. The three common methods of costing are presented. Budgeting distributions are discussed. The use of discounting procedures is outlined. The benefit-cost ratio and cost-effectiveness analysis is defined and their current application to NASA planning is pointed out. Specific practices and techniques are discussed, and actual costing and budgeting procedures are outlined. The recommended method of calculating benefit-cost ratios is described. A standardized method of cost-effectiveness analysis and long-range planning are also discussed. Author

N72-29980# Ad Hoc Committee on the Cumulative Regulatory Effects on the Cost of Automotive Transportation (RECAT).
CUMULATIVE REGULATORY EFFECTS ON THE COST OF AUTOMOTIVE TRANSPORTATION (RECAT) Final Report
28 Feb. 1972 325 p refs Sponsored by Office of Sci. and Technol.
Avail: NTIS HC $18.25

An attempt is made to outline the known and anticipated effects of existing laws and regulations on the cost of automotive transportation in the United States of America. Considered are: emission control, safety, damage limiting design, highway design, and noise reduction rules. Author

N72-29981# Committee on Commerce (U. S. Senate).
REGULATION OF RATES AND PRACTICES OF AIR CARRIERS AND FOREIGN AIR CARRIERS
Washington GPO 1972 281 p refs Hearings on S. 2423 before the Comm. on Com., 92d Congr., 1st Sess., 19-21 Oct. 1971
Avail: Subcomm. on Aviation

Senate hearings on rates and practices of domestic and foreign air carriers are presented. International airline fare-setting practices and procedures, and the recent failure of the International Air Transportation Association to come to an agreement on a common fare package over the North Atlantic are emphasized. The question of whether current procedures and existing U.S. law adequately protect the U.S. traveling public, the U.S. air carriers, and the U.S. air transport system is also discussed. N.E.N.

N72-29982# Civil Aeronautics Board, Washington, D.C.
REMARKS BY SECOR D. BROWNE, CHAIRMAN, CIVIL AERONAUTICS BOARD, BEFORE THE ECONOMICAL CLUB OF DETROIT, DETROIT, MICHIGAN
Secor D. Browne 17 Jan. 1972 6 p
Avail: NTIS HC $3.00

Data covering the future of the airline industry in production transport aircraft are presented. It was suggested that the industry's problems are caused by financial problems and the Government's refusal to give assistance. E.H.W.

N72-29983# Civil Aeronautics Board, Washington, D.C.
REMARKS BY SECOR D. BROWNE, CHAIRMAN, CIVIL AERONAUTICS BOARD, BEFORE THE DOWNTOWN ROTARY CLUB AND THE GREATER TAMPA CHAMBER OF COMMERCE, TAMPA, FLORIDA
Secor D. Browne 1 Feb. 1972 10 p
Avail: NTIS HC $3.00

The financial condition of the airline industry is discussed as well as its problems in producing new aircraft. Special attention is given to the decline of transport aircraft production, and government aid to the industry. E.H.W.

N72-29984# RAND Corp., Santa Monica, Calif.
THE ANALYTICAL ASPECTS OF EVALUATING ON-GOING PROGRAMS
Marjorie L. Rapp Apr. 1972 6 p Presented at the Ann. Meeting of the Am. Educational Res. Assoc., Chicago, 3-7 Apr. 1972
(P-4813) Avail: NTIS HC $3.00

The quantification of educational aspects is discussed briefly and ways in which educators can cooperate with and benefit from analysis are suggested. Underachievers in schools are used as an illustration, and requirements for a good analysis and what can be expected from it are mentioned. N.E.N.

N72-29985# RAND Corp., Santa Monica, Calif.
THE PRICE OF FIRE: THE APPLICATION OF MODERN TECHNOLOGY TO THE IMPROVEMENT OF MAN'S ENVIRONMENT
R. M. Salter and P. T. VanDyke May 1972 28 p refs
(P-4700) Avail: NTIS HC $3.50

Ways in which technology can be applied to the solution of environmental problems are discussed. Environmental technology is divided into monitoring technology and abatement technology, and examples of each are given. The abatement technology is considered with respect to energy production and consumption, transportation, and waste disposal and prevention. Monitoring is accomplished by aircraft and spacecraft surveys, computerized simulation, and a variety of sensors, detectors, and techniques. N.E.N.

N72-29986# Civil Aeronautics Board, Washington, D.C.
[SERVICE TO SMALL COMMUNITIES]
Secor D. Browne 28 Jan. 1972 14 p
Avail: NTIS HC $3.00

Problems facing the aircraft industry and airlines are described. The lack of planned replacements for existing aircraft, and the effect on the balance of payments are discussed as serious problems of the economy. The difficulty encountered by the American companies in raising financial resources for development through production is contrasted with the ease that foreign national airlines can make loans from the Exim Bank for about half the interest rate that the American carriers have to pay in the private sector. Contracts of American companies with foreign governments are cited as representing a reverse brain drain. In addition, airline service to small communities is discussed in terms of problems facing regional carriers. F.O.S.

N72-29987# Committee on Science and Astronautics (U. S. House).
US - USSR COOPERATIVE AGREEMENTS
Washington GPO Aug. 1972 32 p refs Presented to Comm. on Sci. and Astronaut., 92d Congr., 2d Sess., 25 Aug. 1972
Avail: Subcommittee on Intern. Cooperation in Sci. and Space

A report on international cooperation between the U.S.S.R and the U. S. on science and space is presented. The cooperative agreements cover medical science and public health, environment protection, space exploration, and technology developments. E.H.W.

N72-29988# Army Foreign Science and Technology Center, Charlottesville, Va.
ANTIAIRCRAFT DEFENSE HERALD, NO. 9, SEPTEMBER 1971
14 Apr. 1972 181 p refs Transl. into ENGLISH from Vestn. Protivovozdushnoy Oboroni (USSR), no. 9, Sep. 1971
(AD-740484; FSTC-HT-23-1611-72) Avail: NTIS CSCL 15/3

Table of Contents: See that which is new and progressive and introduce it into practice; Educate aviators in a spirit of high responsibility; On combat traditions; Combat activism of the pilot; Communists in the struggle to strengthen discipline; Fire against maneuvering targets; Missile firing competition; Stability of emotions and will; Put cadre training on the level of party requirements; Party-mindedness in teaching military-technical disciplines; A high level of practical training for students; A pilot becomes an academy student; Formation of a young teacher; Methodological training for students; Give the necessary attention to extension study; Improve professional training for engineer-leaders; Beloved profession; Always searching; The operator -- central figure in the crew; The operator is the technician's helper; Adjustment of the BAPK; Operating dehydrators; Additional force automatic device; From a readers' conference; Complex diagram of the T-51 teletype apparatus; Attachment to the T/O simulator; Charging unit; Dynamic medical control over flight personnel; In battle with enemy infantry and tanks; Thirtieth anniversary of Soviet Guards. GRA

N72-29989# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A DUAL INDUSTRY ANALYSIS TO GIVE PERSPECTIVE TO AEROSPACE DEFENSE INDUSTRY PROFITS M.S. Thesis
Michael J. Mruz Mar. 1972 122 p refs
(AD-741411; GSA/SM/72-11) Avail: NTIS CSCL 05/3

The study examines the aggregate profit rates of various samples of aerospace defense contractors within the particular operating environment of the defense and space systems market. To give perspective to this particular operating environment, a parallel study of the public utility industry and its operating environment is also included. The analysis includes a detailed examination of return indices for both industries and a comprehensive description of the particular industry operating environments. The elements of the operating environments studies are capital investment, research and development, demand, competition, and regulation and contracts. GRA

N72-29990# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
AIRDROP SYSTEMS SAFETY Final Report
15 Feb. 1972 24 p refs
(AD-741240; MTP-7-2-506) Avail: NTIS CSCL 15/7

The report describes a method for evaluation of airdrop equipment safety characteristics. It provides procedures for test preparation, initial inspection, preparation of questionnaires, mechanical hazards, electrical hazards, personnel safeguards, and safety measures required on drop zone (land and water). Appendices describe permanently installed airdrop equipment, identify the levels of safety hazards, and provide an example questionnaire. It is applicable to airdrop equipment (restraining, extraction, retardation, and ground impact) for rotary and fixed wing aircraft in the delivery of general materiels, excluding toxic or hazardous items. Author (GRA)

N72-29328* Michigan Univ., Ann Arbor. Willow Run Labs.
A SUMMARY OF MICHIGAN PROGRAM FOR EARTH RESOURCE INFORMATION SYSTEMS
Jon D. Erickson *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 19 p refs (For availability see N72-29327 20-13)
CSCL 05B

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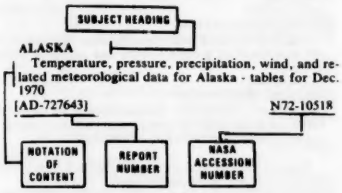

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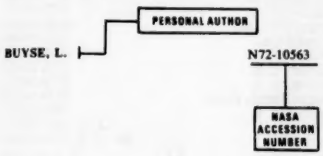

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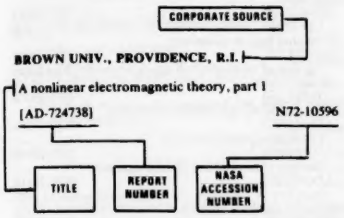

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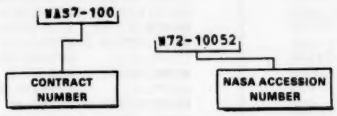

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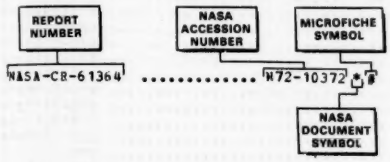

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Second Conference on Portable Life Support Systems (NASA SP–302)

The proceedings of a follow-up conference on the subject, held May 11–13, 1971, at Ames Research Center under the sponsorship of NASA and the Bureau of Mines. The first conference took place almost two years earlier and the papers were published as NASA SP–234, *Portable Life Support Systems. Paperbound.* 364 pp. For sale by the National Technical Information Service, Springfield, Va. 22151, for $6.00.

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